

Haryana Rail Infrastructure Development Corporation Limited

(A Joint Venture Govt. of Haryana and Ministry of Railways)

Plot no.143, Railtel Tower, Sector-44, Floor/ Room number: 5th floor, City: Gurugram,

Zip code: 122003, Country: INDIA

Telephone: +91 8860124749, E-mail: horc.etendering@gmail.com, Website: www.hridc.co.in

Tender No. HORC/HRIDC/SYS-1/2023

Date 28.07.2023

Reference: Specific Procurement Notice dated 29.05.2023.

CORRIGENDUM No. 4

Name of Work: **Contract Package SYS 1:** Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km (-) 2.099 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 315 TKM).

The E-tender No. 2023_HBC_287471_1 for the above mentioned Work was published on 02.06.2023.

Final Tender Document is hereby issued with Corrigendum No. 4 incorporating all the modifications carried out vide Corrigendum No. 1 dated 28.06.2023 Corrigendum No. 2 dated 20.07.2023 and Corrigendum No. 3 dated 25.07.2023. Final Tender Document issued on 28.07.2023 supersedes previously issued Tender Documents dated 02.06.2023.

Tenderers are advised to download Final Tender Document issued vide Corrigendum No. 4 dated 28.07.2023 on eProcurement portal of Govt. of Haryana (<https://etenders.hry.nic.in>) and submit their Tender based on the requirements of Final Tender Document. Section VII-3: Tender Drawings is available for downloading in Active Tender section on HRIDC website (<http://www.hridc.co.in/active-tender.php>). Tender drawings uploaded on HRIDC website for Package SYS-1 shall be deemed to form part of Final Tender Document issued on 28.07.2023.

In case of any discrepancy noticed at any stage i.e. evaluation of Tenders, execution of the Works or final payment of the Contract, the contents of Final Tender Document shall supersede previously issued Tender Document dated 02.06.2023, Corrigendum No. 1, Corrigendum No.2 and Corrigendum No. 3.

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GM/IE&A,

Haryana Rail Infrastructure
Development Corporation Limited Plot
No 143, 5th Floor, Railtel Tower, Sector-
44, Gurugram,
Haryana-122003

HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED

Specific Procurement Notice (SPN)

Procurement of Works (e-Tendering Process Without Prequalification)

Tender No. HORB/HRIDC/SYS-1/2023

Date: 29.05.2023

Country : India

Employer : Haryana Orbital Rail Corporation Limited

Tender Inviting Authority: Haryana Rail Infrastructure Development Corporation Limited
(HRIDC)

Project : Haryana Orbital Rail Corridor Project

Project No : 000741

Contract Title: Contract Package SYS-1 Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORB) Project from Km (-) 2.099 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 315 TKM)

Tender Document to be issued on: 02.06.2023

1. The Government of India (GoI) has applied for financing from the **Asian Infrastructure Investment Bank (AIIB or the Bank)** towards the cost of Part A and Part B of the **Haryana Orbital Rail Corridor (HORB) Project**, and intends to apply part of the proceeds towards payments under the contract for “**Contract Package SYS-1: Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORB) Project from Km (-) 2.099 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 315 TKM).**”
2. Haryana Rail Infrastructure Development Corporation Limited (HRIDC), an implementing agency on behalf of HORCL, now invites online Tenders through e-tendering portal of Govt. of Haryana from eligible Tenderers for **SYS-1** fulfilling the qualification criteria as mentioned in the Tender Document. The completion period of work is **1460 days**. Tenderers are advised to refer the Clauses on Eligibility (Section I-ITT, Clause 4) and minimum

Qualification Criteria (Section III – Evaluation and Qualification Criteria) given in Part 1 of Tender Document to qualify for the participation in the Tender.

3. Tendering will be conducted through International Open Competitive Tendering (IOCT) procedures as specified in the Bank's Procurement Instructions for Recipients (PIR) and is open to all eligible Tenderers.
4. Interested eligible Tenderers may obtain further information from the office of GM/IE&A, HRIDC and inspect the Tender Document during office hours from 0930 to 1800 hours at the address given below:

GM/IE&A,
Haryana Rail Infrastructure Development Corporation Limited,
Plot No 143, 5th Floor, Railtel Tower,
Sector-44, Gurugram,
Haryana-122003
Tel No: +91 8860124749
Email id: horc.etendering@gmail.com

5. The Tender Document in English will be available online on eProcurement portal of Govt. of Haryana (<https://etenders.hry.nic.in>) from **02.06.2023 at 1700 hrs. IST** till **25.08.2023 at 1500 hrs. IST**. The start date of submission of tender on eProcurement portal is **17.08.2023 at 1100 hrs. IST**. There is no cost for the Tender Document. However, at the time of submission of Tender, the Tenderer is required to submit a non-refundable **E-Service fee of INR 1180** as indicated in the table at the end of this SPN. The method of payment of E-Service fee will be online in the eProcurement portal using the electronic payment gateway service. Tenderers will be required to register in the above website.
6. For submission of the Tenders, the Tenderer is required to have Digital Signature Certificate (DSC) from one of the Certifying Authorities (CAs), authorized by Government of India for issuing DSC. Tenderers can see the list of licensed CAs from the link (www.cca.gov.in). Aspiring Tenderers who have not obtained the user ID and password for participating in eProcurement in this Project, may obtain the same from the website: <https://etenders.hry.nic.in>.
7. Tender comprise two Parts, namely the Technical Part and the Financial (Price) Part, and both parts must be simultaneously submitted online on eProcurement portal (<https://etenders.hry.nic.in>) before **25.08.2023 at 1500 hrs. IST**. Tender validity shall be 180 days after the last date of submission of Tenders. Any Tender or modifications to Tender received outside eProcurement system will not be considered. The electronic tendering system would not allow any late submission of Tenders. The "TECHNICAL PART" of the Tenders will be opened online on **25.08.2023 at 1530 hrs. IST** and this could be viewed by the Tenderers online on eProcurement Portal. The "FINANCIAL PART" shall remain in encrypted form in the eProcurement system until the opening. If the office happens to be closed on the date of opening of the Tenders as specified, the Tenders will be opened on the next working day at the same time and venue.
8. All Tenders must be accompanied by a Tender Security of the amount in the currency specified for the Work in the table at the end of this SPN. Tender Security can be paid online on eProcurement Portal in INR in favour of Haryana Rail Infrastructure Development Corporation Limited using the electronic payment gateway service or Tender Security can

be submitted in the form of unconditional Bank Guarantee in INR or the equivalent amount in a freely convertible currency as per Clause ITT 19.3 of TDS. In case the Tenderer has opted for Tender security in the form of an unconditional Bank guarantee, the Tenderer should upload the scanned copy of Bank Guarantee with the Tender. The original Bank Guarantee shall be delivered either by Registered Post / Speed Post/Courier or by hand within ten (10) days of deadline of submission of Tender at the address given below:

GM/IE&A,
Haryana Rail Infrastructure Development Corporation Limited,
Plot No 143, 5th Floor, Railtel Tower,
Sector-44, Gurugram, Haryana-122003

9. A **Pre-Tender Meeting** will be held on **17.06.2023 at 1100 hrs. IST** through online video conferencing as well as offline in the Conference room of HRIDC office, Plot No 143, Railtel Tower, Sector-44, Gurugram, Haryana-122003 to clarify the issues and to answer questions on any matter that may be raised at that stage as stated in ITT Clause 7.4 of 'Instructions to Tenderers' of the Tender Document. Tenderers are advised to download the Tender Document prior to the Pre-Tender Meeting in order for Tenderers to have a good understanding of the scope of the requirements under this contract for discussion and clarification at the Pre-Tender Meeting. Last date for submission of Pre-Tender queries to the Employer is **15.06.2023 by 1800 hrs. IST** after which no queries will be acknowledged. HRIDC's response to Pre-tender queries will be uploaded on or before **20.07.2023**.
10. Other details can be seen in the Tender Document. The Employer shall not be held liable for any delays due to system failure beyond its control. Even though the system will attempt to notify the Tenderers of any updates, the Employer shall not be liable for any information not received by the Tenderer. It is the Tenderers' responsibility to verify the HRIDC website (<http://www.hridc.co.in>) and eProcurement portal of Govt. of Haryana (<https://etenders.hry.nic.in>) for the latest information related to this Tender.

TABLE

Package No.	Name of Work	Tender Security	Cost of Tender Document	E-Service fee	Time for Completion
1	2	3	4	5	6
SYS-1	Contract Package SYS-1: Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km (-) 2.099 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from	INR 10 million OR the equivalent amount in a freely convertible currency	NIL	INR 1180 (including GST)	1460 days

km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 315 TKM).				
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GM/IE&A,
Haryana Rail Infrastructure
Development Corporation
Limited Plot No 143, 5th Floor,
Railtel Tower, Sector-44,
Gurugram,
Haryana-122003

Final Tender Document for Works

(Two-Envelope Tendering Process Without Prequalification)

Procurement of:

Contract Package SYS-1: Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km (-) 2.099 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 315 TKM).

Tender No: HORC/HRIDC/SYS-1/2023

Contract title: OHE, Power Supply System, SCADA and ROCS Works on EPC basis (SYS-1)

Project: Haryana Orbital Rail Corridor Project

Loan No.: 000741

Employer: Haryana Orbital Rail Corporation Limited

Country: INDIA

Issued on: 28.07.2023

Summary

Specific Procurement Notice (SPN)

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- Section II - Tender Data Sheet (TDS)
- Section III - Evaluation and Qualification Criteria
- Section IV - Tender Forms
- Section V - Eligible Countries
- Section VI - Prohibited Practices

PART 2 – EMPLOYER’S REQUIREMENTS

- Section VII - Employer’s Requirements

PART 3 – CONDITIONS OF CONTRACT AND CONTRACT FORMS

- Section VIII - General Conditions of Contract (GCC)
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PART 1 – Tendering Procedures

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Section I - Instructions to Tenderers (ITT)

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Section I - Instructions to Tenderers (ITT)

A. General

- 1. Scope of Tender**
- 1.1 In connection with the Specific Procurement Notice (SPN) indicated in the **Tender Data Sheet (TDS)**, the Employer, as specified in the **TDS**, issues this Tender Document for the provision of Works on EPC basis as specified in Section VII, Employer's Requirements. The name, identification, and number of lots (contracts) of this tender are specified in the **TDS**.
- 1.2 Throughout this Tender Document:
- (a) the term "in writing" means communicated in written form (e.g., by mail, e-mail, fax, including, if specified in the **TDS**, distributed or received through electronic-procurement system used by the Employer) with proof of receipt;
 - (b) if the context so requires, "singular" means "plural" and vice versa;
 - (c) "Day" means calendar day, unless otherwise specified as a "Business Day." A Business Day is any day that is a working day of the Recipient. It excludes the Recipient's official public holidays;
 - (d) "ESHS" means environmental, social, health and safety; and
 - (e) the word "tender" is synonymous with "bid" and "tenderer" with "bidder", and the words "tender documents" with "bidding documents".
- 2. Source of Funds**
- 2.1 The Recipient specified in the **TDS** has received or has applied for financing (hereinafter called "funds") from the Asian Infrastructure Investment Bank (hereinafter called ("AIIB" or "the Bank") in an amount specified in the **TDS**, toward the project named in the **TDS**. The Recipient intends to apply a portion of the funds to eligible payments under the contract(s) for which this Tender Document is issued.
- 2.2 Payment by the Bank will be made only at the request of the Recipient and upon approval by the Bank, and will be subject, in all respects, to the terms and conditions of the Loan (or other financing) Agreement. The Loan (or other financing) Agreement prohibits a withdrawal from the loan account for the purpose of any payment to persons or entities, or for any import of goods, equipment, plant, or materials, if such payment or import is prohibited by a decision of

the United Nations Security Council taken under Chapter VII of the Charter of the United Nations. No party other than the Recipient shall derive any rights from the Loan (or other financing) Agreement or have any claim to the proceeds of the Loan (or other financing).

3. Prohibited Practices

- 3.1 The Bank requires compliance with the Bank’s Policy on Prohibited Practices as set forth in Section VI.
- 3.2 In further pursuance of this policy, Tenderers shall permit and shall cause their agents (whether declared or not), subcontractors, sub-consultants, service providers, suppliers, and their personnel, to permit the Bank to inspect all accounts, records and other documents relating to any prequalification process, tender submission, proposal submission, and contract performance (in the case of award), and to have them audited by auditors appointed by the Bank.

4. Eligible Tenderers

- 4.1 A Tenderer may be a firm that is a private entity, a state-owned enterprise or institution subject to ITT 4.6 or any combination of such entities in the form of a joint venture (JV) under an existing agreement or with the intent to enter into such an agreement supported by a letter of intent. In the case of a joint venture, all members shall be jointly and severally liable for the execution of the entire Contract in accordance with the Contract terms. The JV shall nominate a Representative who shall have the authority to conduct all business for and on behalf of any and all the members of the JV during the Tendering process and, in the event the JV is awarded the Contract, during contract execution. Unless specified in the **TDS**, there is no limit on the number of members in a JV.
- 4.2 A Tenderer shall not have a conflict of interest. Any Tenderer found to have a conflict of interest shall be disqualified. A Tenderer may be considered to have a conflict of interest for the purpose of this Tendering process, if the Tenderer:
- a) directly or indirectly controls, is controlled by or is under common control with another Tenderer; or
 - b) receives or has received any direct or indirect subsidy from another Tenderer; or
 - c) has the same legal representative as another Tenderer; or
 - d) has a relationship with another Tenderer, directly or through common third parties, that puts it in a position to influence the Tender of another Tenderer, or influence the decisions of the Employer regarding this Tendering process; or
 - e) or any of its affiliates participated as a consultant in the preparation of the design or technical specifications of the Works that are the subject of the Tender; or

- f) or any of its affiliates has been hired (or is proposed to be hired) by the Employer or Recipient as Engineer for the Contract implementation; or
- g) would be providing goods, works, or non-consulting services resulting from or directly related to consulting services for the preparation or implementation of the project specified in the TDS ITT 2.1 that it provided or were provided by any affiliate that directly or indirectly controls, is controlled by, or is under common control with that firm; or
- h) has a close business or family relationship with a professional staff of the Recipient (or of the project implementing agency, or of any other beneficiary of the Bank's financing, or of any other party representing or acting on behalf of the Recipient) who: (i) are directly or indirectly involved in the preparation of the Tender Document or specification of the Contract, and/or the Tender evaluation process of such Contract; or (ii) would be involved in the implementation or supervision of such Contract unless the conflict stemming from such relationship has been resolved in a manner acceptable to the Bank throughout the Tendering process and execution of the Contract; or
- i) is an affiliate of the Recipient, or of a procurement agent engaged by the Recipient, unless the Recipient demonstrates to the satisfaction of the Bank that there is no significant degree of common ownership, influence or control between the Recipient on the one hand, and the Recipient's agent and the affiliate on the other.

4.3 A firm that is a Tenderer (either individually or as a JV member) shall not participate in more than one Tender, except for permitted alternative Tenders. Such participation shall result in the disqualification of all Tenders in which the firm is involved. However, this does not limit: (a) the inclusion of the same Subcontractor in more than one Tender for the same contract; or (b) the ability of one Tenderer to be a Subcontractor in another Tender for the same contract.

4.4 A Tenderer may have the nationality of any country, subject to the restrictions pursuant to ITT 4.8. A Tenderer shall be deemed to have the nationality of a country if the Tenderer is constituted, incorporated or registered in and operates in conformity with the provisions of the laws of that country, as evidenced by its articles of incorporation (or equivalent documents of constitution or association) and its registration documents, as the case may be. This criterion also shall apply to the determination of the nationality of

proposed subcontractors or sub-consultants for any part of the Contract including related Services.

- 4.5 A Tenderer that has been declared, and remains, as at the relevant date, ineligible pursuant to the Bank's Policy on Prohibited Practices as described in Section VI, shall be ineligible to be prequalified for, tender for, propose for, or be awarded a Bank-financed contract or benefit from a Bank-financed contract, financially or otherwise, during such period of time as the Bank shall have determined. The list of debarred firms and individuals is available at the electronic address specified in the **TDS**.
- 4.6 Tenderers that are state-owned enterprises or institutions in the Employer's Country may be eligible to compete and be awarded a Contract(s) only if they can establish, in a manner acceptable to the Bank, that they (i) are carrying-out or are established for a business purpose, and are operating on a commercial basis; (ii) are financially and managerially autonomous; (iii) are not controlled by the government on day-to-day management; and (iv) are not under the supervision of the Employer or its procuring agency.
- 4.7 A Tenderer shall not be under suspension from Tendering by the Employer as the result of the operation of a Tender–Securing or Proposal-Securing Declaration.
- 4.8 Firms and individuals may be ineligible if so indicated in Section V and (a) as a matter of law or official regulations, the Recipient's country prohibits commercial relations with the firm or individual's country, provided that the Bank is satisfied that such exclusion does not preclude effective competition for the supply of goods or the contracting of works or services required; or (b) by an act of compliance with a decision of the United Nations Security Council taken under Chapter VII of the Charter of the United Nations, the Recipient's country prohibits any import of goods or contracting of works or services from the firm or individual's country, or any payments to any country, person, or entity in that country. When the Works are implemented across jurisdictional boundaries (and more than one country is a Recipient, and is involved in the procurement), then exclusion of a firm or individual on the basis of ITT 4.8 (a) above by any country may be applied to that procurement across other countries involved, if the Bank and the Recipients involved in the procurement agree.
- 4.9 A Tenderer shall provide such documentary evidence of eligibility satisfactory to the Employer, as the Employer shall reasonably request.

4.10 A firm that is under a sanction of debarment by the Recipient from being awarded a contract is eligible to participate in this procurement, unless the Bank, at the Recipient's request, is satisfied that the debarment; (a) relates to fraud or corruption or other prohibited practices, and (b) followed a judicial or administrative proceeding that afforded the firm adequate due process.

5. Eligible Materials, Equipment, and Services

5.1 The materials, equipment and services to be supplied under the Contract and financed by the Bank may have their origin in any country subject to the restrictions specified in Section V, Eligible Countries, and all expenditures under the Contract will not contravene such restrictions. At the Employer's request, Tenderers may be required to provide evidence of the origin of materials, equipment and services.

B. Contents of Tender Document

6. Sections of Tender Document

6.1 The Tender Document consists of Parts 1, 2 and 3, includes all the sections specified below, and should be read in conjunction with any Addenda issued in accordance with ITT 8.

PART 1 Tendering Procedures

- Section I - Instructions to Tenderers (ITT)
- Section II - Tender Data Sheet (TDS)
- Section III - Evaluation and Qualification Criteria
- Section IV - Tender Forms
- Section V - Eligible Countries
- Section VI - Prohibited Practices

PART 2 Employer's Requirements

Section VII - Employer's Requirements

PART 3 Conditions of Contract and Contract Forms

- Section VIII - General Conditions of Contract (GCC)
- Section IX - Particular Conditions of Contract (PCC)
- Section X - Contract Forms

6.2 The Specific Procurement Notice issued by the Employer is not part of the Tender Document.

6.3 Unless obtained directly from the Employer, the Employer is not responsible for the completeness of the Tender Document, responses to requests for clarification, the minutes of the pre-Tender meeting (if any),

or Addenda to the Tender Document in accordance with ITT 8. In case of any contradiction, documents obtained directly from the Employer shall prevail.

6.4 The Tenderer is expected to examine all instructions, forms, terms, and specifications in the Tender Document and to furnish with its Tender all information and documentation as is required by the Tender Document.

7. Clarification of Tender Document, Site Visit, Pre-Tender Meeting

7.1 A Tenderer requiring any clarification of the Tender Document shall contact the Employer in writing at the Employer's address specified in the **TDS** or raise its enquiries during the pre-Tender meeting if provided for in accordance with ITT 7.4. The Employer will respond in writing to any request for clarification, provided that such request is received no later than 22.07.2022, 1800 Hrs IST. The Employer shall forward copies of its response to all Tenderers who have acquired the Tender Document in accordance with ITT 6.3, including a description of the inquiry but without identifying its source. If so, specified in the **TDS**, the Employer shall also promptly publish its response at the web page identified in the **TDS**. Should the clarification result in changes to the essential elements of the Tender Document, the Employer shall amend the Tender Document following the procedure under ITT 8 and ITT 22.2.

7.2 The Tenderer is advised to visit and examine the Site of Works and its surroundings and obtain for itself on its own responsibility all information that may be necessary for preparing the Tender and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the Tenderer's own expense.

7.3 The Tenderer and any of its personnel or agents will be granted permission by the Employer to enter upon its premises and lands for the purpose of such visit, but only upon the express condition that the Tenderer, its personnel, and agents will release and indemnify the Employer and its personnel and agents from and against all liability in respect thereof, and will be responsible for death or personal injury, loss of or damage to property, and any other loss, damage, costs, and expenses incurred as a result of the inspection.

7.4 If so specified in the **TDS**, the Tenderer's designated representative is invited to attend a pre-Tender meeting and/or a Site of Works visit. The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.

7.5 The Tenderer is requested to submit any questions in writing, to reach the Employer not later than one week before the meeting.

7.6 Minutes of the pre-Tender meeting, if applicable, including the text of the questions asked by Tenderers, without identifying the source, and the responses given, together with any responses prepared after the meeting, will be transmitted promptly to all Tenderers who have acquired the Tender Document in accordance with ITT 6.3. If so, specified in the **TDS**, the Employer shall also promptly publish the Minutes of the pre-Tender meeting at the web page identified in the **TDS**. Any modification to the Tender Document that may become necessary as a result of the pre-Tender meeting shall be made by the Employer exclusively through the issue of an Addendum pursuant to ITT 8 and not through the minutes of the pre-Tender meeting. Nonattendance at the pre-Tender meeting will not be a cause for disqualification of a Tenderer.

8. Amendment of Tender Document

8.1 At any time prior to the deadline for submission of Tenders, the Employer may amend the Tender Document by issuing addenda.

8.2 Any addendum issued shall be part of the Tender Document and shall be communicated in writing to all who have obtained the Tender Document from the Employer in accordance with ITT 6.3. The Employer shall also promptly publish the addendum on the Employer's web page in accordance with ITT 7.1.

8.3 To give Tenderers reasonable time in which to take an addendum into account in preparing their Tenders, the Employer may, at its discretion, extend the deadline for the submission of Tenders, pursuant to ITT 22.2.

C. Preparation of Tenders

9. Cost of Tendering

9.1 The Tenderer shall bear all costs associated with the preparation and submission of its Tender, and the Employer shall not be responsible or liable for those costs, regardless of the conduct or outcome of the Tendering process.

10. Language of Tender

10.1 The Tender, as well as all correspondence and documents relating to the Tender exchanged by the Tenderer and the Employer, shall be written in the language specified in the **TDS**. Supporting documents and printed literature that are part of the Tender may be in another language provided they are accompanied by an accurate translation of the relevant passages in the language specified in the **TDS**, in which case, for purposes of interpretation of the Tender, such translation shall govern.

11. Documents Comprising the Tender

11.1 The Tender shall comprise two Parts, namely the Technical Part and the Financial Part. These two Parts shall be submitted simultaneously in two separate sealed envelopes (two-envelope tendering process).

One envelope shall contain only information relating to the Technical Part and the other, only information relating to the Financial Part. These two envelopes shall be enclosed in a separate sealed outer envelope marked “ORIGINAL TENDER”.

11.2 The Technical Part shall contain the following:

- (a) Letter of Tender – Technical Part: prepared in accordance with ITT 12;
- (b) Tender Security or Tender-Securing Declaration: in accordance with ITT 19.1;
- (c) Alternative Tender – Technical Part: if permissible, in accordance with ITT 13;
- (d) Authorization: written confirmation authorizing the signatory of the Tender to commit the Tenderer, in accordance with ITT 20.3;
- (e) Eligibility: documentary evidence in accordance with ITT 17.1 establishing the Tenderer’s eligibility to tender;
- (f) Qualifications: documentary evidence in accordance with ITT 17.2 establishing the Tenderer’s qualifications to perform the Contract if its Tender is accepted;
- (g) Conformity: a technical proposal in accordance with ITT 16;
- (h) Any other document required in the **TDS**.

11.3 The Financial Part shall contain the following:

- (a) Letter of Tender – Financial Part: prepared in accordance with ITT 12 and ITT 14;
- (b) Price Schedule: completed in accordance with ITT 12 and ITT 14;
- (c) Alternative Tender - Financial Part: if permissible in accordance with ITT 13; and
- (d) Any other document required in the **TDS**.

11.4 The Technical Part shall not include any information related to the Tender price. Where material financial information related to the Tender price is contained in the Technical Part, the Tender shall be declared non-responsive.

11.5 In addition to the requirements under ITT 11.2, Tenders submitted by a JV shall include a copy of the Joint Venture Agreement entered into by all members. Alternatively, a letter of intent to execute a Joint Venture Agreement in the event of a successful Tender shall be

signed by all members and submitted with the Tender, together with a copy of the proposed Agreement.

11.6 The Tenderer shall furnish in the Letter of Tender – Financial Part information on commissions and gratuities, if any, paid or to be paid to agents or any other party relating to this Tender.

12. Letter of Tender and Schedules

12.1 The Letter of Tender – Technical Part, the Letter of Tender – Financial Part, Schedules and all documents listed under ITT 11 including the Price Schedule, shall be prepared using the relevant forms furnished in Section IV, Tender Forms. The forms must be completed without any alterations to the text, and no substitutes shall be accepted except as provided under ITT 20.3. All blank spaces shall be filled in with the information requested.

13. Alternative Tenders

13.1 Unless otherwise specified in the **TDS**, alternative Tenders shall not be considered.

13.2 When alternative times for completion are explicitly invited, a statement to that effect will be included in the **TDS**, and the method of evaluating different alternative times for completion will be described in Section III, Evaluation and Qualification Criteria.

13.3 Except as provided under ITT 13.4 below, Tenderers wishing to offer technical alternatives to the requirements of the Tender Document must first price the Employer’s design as described in the Tender Document and shall further provide all information necessary for a complete evaluation of the alternative by the Employer, including drawings, design calculations, technical specifications, breakdown of prices, and proposed construction methodology and other relevant details. Only the technical alternatives, if any, of the Tenderer with the Most Advantageous Tender conforming to the basic technical requirements shall be considered by the Employer.

13.4 When specified in the **TDS**, Tenderers are permitted to submit alternative technical solutions for specified parts of the Works. Such parts will be identified in the **TDS** and described in Section VII, Employer’s Requirements. The method for their evaluation will be stipulated in Section III, Evaluation and Qualification Criteria.

14. Tender Prices and Discounts

14.1 The prices and discounts (including any price reduction) quoted by the Tenderer in the Letter of Tender – Financial Part and in the Price Schedule shall conform to the requirements specified below.

14.2 Unless otherwise specified in the **TDS**, Tenderers shall quote for the entire Works on a “single responsibility” basis such that the total lump sum Tender price, subject to any adjustments, in accordance with the Contract, covers all the Contractor’s obligations mentioned in or to be reasonably inferred from the Tendering document for

complete execution of the Works on EPC basis. This includes all requirements under the Contractor's responsibilities for design, construction, procurement, erection, installation, subcontracting (if any), testing, pre-commissioning and commissioning (as applicable) of the Works and, where so required by the Tendering document, the acquisition of all permits, approvals and licenses, etc.; the operation, maintenance and training services and such other items and services as may be specified in the Tendering document, all in accordance with the requirements of the General Conditions.

Tenderers shall give a breakdown of the prices in the manner and detail called for in the Schedule of Rates and prices (if any) included in Section IV, Tender Forms. These will not in any way limit the Tenderers' single point total responsibility for the complete Scope of Work and for all contractual responsibilities/ obligations as stated in the Tendering Document.

- 14.3 The price to be quoted in the Letter of Tender – Financial Part, in accordance with ITT 12.1, shall be the total price of the Tender, excluding any discounts offered.
- 14.4 The Tenderer shall quote any discounts and the methodology for their application in the Letter of Tender – Financial Part, in accordance with ITT 12.1.
- 14.5 Unless otherwise specified in the **TDS** and the Conditions of Contract, the rates and prices quoted by the Tenderer are subject to adjustment during the performance of the Contract in accordance with the provisions of the Conditions of Contract. In such a case, the Tenderer shall furnish the indices and weightings for the price adjustment formulae in the Table of Adjustment Data in Section IV, Tender Forms, and the Employer may require the Tenderer to justify its proposed indices and weightings.
- 14.6 If so specified in ITT 1.1, Tenders are being invited for individual lots (contracts) or for any combination of lots (packages). Tenderers wishing to offer discounts for the award of more than one Contract shall specify in their Tender the price reductions applicable to each package, or alternatively, to individual Contracts within the package. Discounts shall be submitted in accordance with ITT 14.4, provided the Tenders for all lots (contracts) are opened at the same time. If, however, rated criteria are used in accordance with ITT 30.2, discounts on condition of award of more than one Contract shall not be used for Tender evaluation purpose.
- 14.7 All duties, taxes, and other levies payable by the Contractor under the Contract, or for any other cause, as of the date 28 days prior to

the deadline for submission of Tenders, shall be included in the rates and prices and the total Tender Price submitted by the Tenderer.

- 15. Currencies of Tender and Payment**
- 15.1 The currency (ies) of the Tender and the currency (ies) of payments shall be the same and shall be as specified in the **TDS**.
- 15.2 Tenderers may be required by the Employer to justify, to the Employer's satisfaction, their local and foreign currency requirements, and to substantiate that the amounts included in the unit rates and prices and shown in the Table of Adjustment Data in the Appendix to Tender in Section IV, Tender Forms, are reasonable, in which case a detailed breakdown of the foreign currency requirements shall be provided by Tenderers.
- 16. Documents Comprising the Technical Proposal**
- 16.1 The Tenderer shall furnish a technical proposal in the Technical Part of the Tender including a statement of work methods, equipment, personnel, schedules and any other information as stipulated in Section IV, Tender Forms, in sufficient detail to demonstrate the adequacy of the Tenderer's proposal to meet the Employer's requirements and the completion time.
- 17. Documents Establishing the Eligibility and Qualifications of the Tenderer**
- 17.1 To establish Tenderer's eligibility in accordance with ITT 4, Tenderers shall complete the Letter of Tender – Technical Part, included in Section IV, Tender Forms.
- 17.2 In accordance with Section III, Evaluation and Qualification Criteria, to establish its qualifications to perform the Contract, the Tenderer shall provide the information requested in the corresponding information sheets included in Section IV, Tender Forms.
- 17.3 If provisions for development of domestic industry (such as a margin of domestic preference) apply as specified in accordance with ITT 38.1, domestic Tenderers, individually or in joint ventures, applying for eligibility for domestic preference shall supply all information required to satisfy the criteria for eligibility specified in accordance with ITT 38.1.
- 18. Period of Validity of Tenders**
- 18.1. Tenders shall remain valid for the Tender Validity period specified in the **TDS**. The Tender Validity period starts from the date fixed for the Tender submission deadline (as prescribed by the Employer in accordance with ITT 22). A Tender valid for a shorter period shall be rejected by the Employer as nonresponsive.
- 18.2. In exceptional circumstances, prior to the expiration of the Tender validity period, the Employer may request Tenderers to extend the period of validity of their Tenders. The request and the responses shall be made in writing. If a Tender Security is requested in accordance with ITT 19, it shall also be extended for a corresponding period. A Tenderer

may refuse the request without forfeiting its Tender security. A Tenderer granting the request shall not be required or permitted to modify its Tender, except as provided in ITT 18.3.

18.3. If the award is delayed by a period exceeding fifty-six (56) days beyond the expiry of the initial Tender validity period, the Contract price shall be determined as follows:

- (a) in the case of fixed price contracts, the Contract price shall be the Tender price adjusted by the factor specified in the **TDS**;
- (b) in the case of adjustable price contracts, no adjustment shall be made; or
- (c) in any case, Tender evaluation shall be based on the Tender price without taking into consideration the applicable correction from those indicated above.

19. Tender Security

19.1 The Tenderer shall furnish as part of the Technical Part of its Tender, either a Tender Security or a Tender-Securing Declaration, as specified in the **TDS**, in original form and, in the case of a Tender Security, in the amount and currency, or in the case of a Tender-Securing Declaration, for the period of ineligibility, as specified in the **TDS**.

19.2 A Tender-Securing Declaration shall use the form included in Section IV, Tender Forms.

19.3 If a Tender Security is specified pursuant to ITT 19.1, the Tender Security shall be a demand guarantee in any of the following forms at the Tenderer's option:

- (a) an unconditional guarantee issued by a bank;
- (b) an irrevocable letter of credit;
- (c) a cashier's or certified check; or
- (d) another security specified in the **TDS**,

from a reputable source from an eligible country. In the case of a bank guarantee, the Tender Security shall be submitted either using the Tender Security Form included in Section IV, Tender Forms, or in another substantially similar format approved by the Employer prior to Tender submission. The Tender Security shall be valid for twenty-eight (28) days beyond the original validity period of the Tender, or beyond any period of extension if requested under ITT 18.2.

19.4 If a Tender Security or Tender-Securing Declaration is specified pursuant to ITT 19.1, any Tender not accompanied by a substantially

responsive Tender Security or Tender-Securing Declaration shall be rejected by the Employer as non-responsive.

19.5 If a Tender Security is specified pursuant to ITT 19.1, the Tender Security of unsuccessful Tenderers shall be returned as promptly as possible upon the successful Tenderer's signing the Contract and furnishing the Performance Security pursuant to ITT 50.

19.6 The Tender Security of the successful Tenderer shall be returned as promptly as possible once the successful Tenderer has signed the Contract and furnished the required Performance Security.

19.7 The Tender Security may be forfeited, or the Tender-Securing Declaration executed:

- (a) if a Tenderer withdraws its Tender during the period of Tender validity specified by the Tenderer on the Letter of Tender, or any extension thereto provided by the Tenderer; or
- (b) if the successful Tenderer fails to:
 - (i) sign the Contract in accordance with ITT 49; or
 - (ii) furnish a Performance Security in accordance with ITT 50.

19.8 The Tender Security or the Tender-Securing Declaration of a JV shall be in the name of the JV that submits the Tender. If the JV has not been legally constituted into a legally enforceable JV at the time of Tendering, the Tender Security or the Tender-Securing Declaration shall be in the names of all future members as named in the letter of intent referred to in ITT 4.1 and ITT 11.5.

20. Format and Signing of Tender

20.1 The Tenderer shall prepare one original set of the Technical Part of the Tender and one original set of the Financial Part of the Tender as described in ITT 11 and ITT 21, and clearly mark them "ORIGINAL". Alternative Tenders, if permitted in accordance with ITT 13, shall be clearly marked "ALTERNATIVE." In addition, the Tenderer shall submit copies of the Tender, in the number specified in the **TDS** and clearly mark them "COPY". In the event of any discrepancy between the original and the copies, the original shall prevail.

20.2 Tenderers shall mark as "CONFIDENTIAL" all information in their Tenders which is confidential to their business. This may include proprietary information, trade secrets, or commercial or financially sensitive information.

20.3 The original and all copies of the Tender shall be typed or written in indelible ink and shall be signed by a person duly authorized to sign on behalf of the Tenderer. This authorization shall consist of a written confirmation as specified in the **TDS** and shall be attached to

the Tender. The name and position held by each person signing the authorization must be typed or printed below the signature. All pages of the Tender where entries or amendments have been made shall be signed or initialed by the person signing the Tender.

- 20.4 In case the Tenderer is a JV, the Tender shall be signed by an authorized representative of the JV on behalf of the JV, and so as to be legally binding on all the members as evidenced by a power of attorney signed by their legally authorized representatives.
- 20.5 Any amendments such as inter-lineation, erasures, or overwriting shall be valid only if they are signed or initialed by the person signing the Tender.

D. Submission of Tenders

21. Sealing and Marking of Tenders

21.1 Tenderers may submit their Tenders by mail or by hand. If so specified in the TDS, Tenderers shall have the option of submitting their Tenders electronically. Procedures for submission, sealing, and marking are as follows:

- (a) Tenderers submitting Tenders by mail or by hand shall enclose the original Technical Part of the Tender, the original Financial Part of the Tender, and the respective copies of the Tender, including Alternative Tenders if permitted in accordance with ITT 13, in separate sealed envelopes. The envelopes shall be duly marked as "ORIGINAL TECHNICAL PART", "ORIGINAL-FINANCIAL PART", "COPY-TECHNICAL PART", "COPY-FINANCIAL PART", "ALTERNATIVE-ORIGINAL-TECHNICAL PART", "ALTERNATIVE-ORIGINAL-FINANCIAL PART", "ALTERNATIVE-COPY-TECHNICAL PART", and "ALTERNATIVE-COPY-FINANCIAL PART". These envelopes shall then be enclosed in one single package. The rest of the procedure shall be in accordance with ITT 21.2 through ITT 21.5.
- (b) Tenderers submitting Tenders electronically shall follow the electronic tender submission procedures specified in the **TDS**.

21.2 The inner and outer envelopes shall:

- (a) bear the name and address of the Tenderer;
- (b) be addressed to the Employer in accordance with ITT 22.1; and
- (c) bear the specific identification of this Tendering process specified in accordance with TDS ITT 1.1.

- 21.3 The outer envelopes and the inner envelopes containing the Technical Part of Tender shall bear a warning not to open before the time and date for the opening of Technical Part of Tender, in accordance with ITT 25.1.
- 21.4 The inner envelopes containing the Financial Part of Tender shall bear a warning not to open until advised by the Employer in accordance with ITT34.
- 21.5 If all envelopes are not sealed and marked as required, the Employer will assume no responsibility for the misplacement or premature opening of the Tender.
- 22. Deadline for Submission of Tenders**
- 22.1 Tenders must be received by the Employer at the address and no later than the date and time specified in the **TDS**.
- 22.2 The Employer may, at its discretion, extend the deadline for the submission of Tenders by amending the Tender Document in accordance with ITT 8, in which case all rights and obligations of the Employer and Tenderers previously subject to the deadline shall thereafter be subject to the deadline as extended.
- 23. Late Tenders**
- 23.1 The Employer shall not consider any Tender that arrives after the deadline for submission of Tenders, in accordance with ITT 22. Any Tender received by the Employer after the deadline for submission of Tenders shall be declared late, rejected, and returned unopened to the Tenderer.
- 24. Withdrawal, Substitution, and Modification of Tenders**
- 24.1 A Tenderer may withdraw, substitute, or modify its Tender after it has been submitted by sending a written notice, duly signed by an authorized representative, and shall include a copy of the authorization in accordance with ITT 20.3 (except that withdrawal notices do not require copies). The corresponding substitution or modification of the Tender must accompany the respective written notice. All notices must be:
- (a) prepared and submitted in accordance with ITT 20 and ITT 21 (except that withdrawals notices do not require copies), and in addition, the respective envelopes shall be clearly marked “WITHDRAWAL”, “SUBSTITUTION”, “MODIFICATION”; and
 - (b) received by the Employer prior to the deadline prescribed for submission of Tenders, in accordance with ITT 22.
- 24.2 Tenders requested to be withdrawn in accordance with ITT 24.1 shall be returned unopened to the Tenderers.
- 24.3 No Tender may be withdrawn, substituted, or modified in the interval between the deadline for submission of Tenders and the expiration

of the period of Tender validity specified by the Tenderer on the Letter of Tender or any extension thereof.

E. Public Opening of Technical Parts of Tenders

25. Technical Part Opening

- 25.1 Except in the cases specified in ITT 23 and ITT 24.2, the Employer shall publicly open and read out in accordance with this ITT all Tenders received by the deadline, at the date, time and place specified in the **TDS**, in the presence of Tenderers' designated representatives and anyone who chooses to attend. Any specific electronic Tender opening procedures required if electronic Tendering is permitted in accordance with ITT 21.1, shall be as specified in the **TDS**.
- 25.2 First, envelopes marked "Withdrawal" shall be opened and read out and the envelope with the corresponding Tender shall not be opened, but returned to the Tenderer. No Tender withdrawal shall be permitted unless the corresponding withdrawal notice contains a valid authorization to request the withdrawal and is read out at Tender opening.
- 25.3 Next, envelopes marked "Substitution" shall be opened and read out and exchanged with the corresponding Tender being substituted, and the substituted Tender shall not be opened, but returned to the Tenderer. No Tender substitution shall be permitted unless the corresponding substitution notice contains a valid authorization to request the substitution and is read out at Tender opening.
- 25.4 Next, envelopes marked "Modification" shall be opened and read out with the corresponding Tender. No Tender modification shall be permitted unless the corresponding modification notice contains a valid authorization to request the modification and is read out at Tender opening.
- 25.5 Next, all remaining envelopes marked "TECHNICAL PART" shall be opened one at a time. All envelopes marked "FINANCIAL PART" shall remain sealed, and kept by the Employer in safe custody until they are opened, at a later public opening, following the evaluation of the Technical Part of the Tenders. On opening the envelopes marked "TECHNICAL PART" the Employer shall read out: the name of the Tender, the presence or the absence of a Tender Security, or Tender-Securing Declaration, if required, and whether there is a modification; and Alternative Tender - Technical Part; and any other details as the Employer may consider appropriate.

- 25.6 Only Technical Parts of Tenders and Technical Parts of Alternative Tenders that are opened and read out at Tender opening shall be considered further for evaluation. The Letter of Tender – Technical Part and the separate sealed envelopes marked “FINANCIAL PART” are to be initialed by representatives of the Employer attending Tender opening in the manner specified in the **TDS**.
- 25.7 At the tender opening the Employer shall neither discuss the merits of any Tender nor reject any Tender (except for late Tenders, in accordance with ITT 23.1).
- 25.8 The Employer shall prepare a record of the Technical Part of Tender opening that shall include, as a minimum:
- (a) the name of the Tenderer and whether there is a withdrawal, substitution, or modification;
 - (b) the receipt of envelopes marked “FINANCIAL PART”;
 - (c) the presence or absence of a Tender Security or Tender-Securing Declaration, if one was required any alternative Tenders; and
 - (d) if applicable, any Alternative Tender – Technical Part.
- 25.9 The Tenderers’ representatives who are present shall be requested to sign the record. The omission of a Tenderer’s signature on the record shall not invalidate the contents and effect of the record. A copy of the record shall be distributed to all Tenderers who submitted Tenders in time and posted online when electronic Tendering is permitted.

F. Evaluation of Tenders – General Provisions

- 26. Confidentiality**
- 26.1 Information relating to the evaluation of Tenders and recommendation of contract award shall not be disclosed to Tenderers or any other persons not officially concerned with the Tendering process until information on Intention to Award the Contract is transmitted to all Tenderers in accordance with ITT 45.
- 26.2 Any attempt by a Tenderer to influence the Employer in the evaluation of the Tenders or Contract award decisions may result in the rejection of its Tender.
- 26.3 Notwithstanding ITT 26.2, from the time of Tender opening to the time of Contract award, if a Tenderer wishes to contact the Employer

on any matter related to the Tendering process, it shall do so in writing.

27. Clarification of Tenders

- 27.1 To assist in the examination, evaluation, and comparison of the Tenders, and qualification of the Tenderers, the Employer may, at its discretion, ask any Tenderer for a clarification of its Tender, allowing a reasonable time for response. Any clarification submitted by a Tenderer that is not in response to a request by the Employer shall not be considered. The Employer’s request for clarification and the response shall be in writing. No change, including any voluntary increase or decrease, in the prices or substance of the Tender shall be sought, offered, or permitted, except to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the Tenders, in accordance with ITT 36.
- 27.2 If a Tenderer does not provide clarifications of its Tender by the date and time set in the Employer’s request for clarification, its Tender may be rejected.

28. Deviations, Reservations, and Omissions

- 28.1 During the evaluation of Tenders, the following definitions apply:
- (a) “Deviation” is a departure from the requirements specified in the Tender Document;
 - (b) “Reservation” is the setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Tender Document; and
 - (c) “Omission” is the failure to submit part or all of the information or documentation required in the Tender Document.

29. Nonmaterial Nonconformities

- 29.1 Provided that a Tender is substantially responsive, the Employer may waive any nonconformities in the Tender.
- 29.2 Provided that a Tender is substantially responsive, the Employer may request that the Tenderer submit the necessary information or documentation, within a reasonable period of time, to rectify nonmaterial nonconformities or omissions in the Tender related to documentation requirements. Requesting information or documentation on such nonconformities or omissions shall not be related to any aspect of the price of the Tender. Failure of the Tenderer to comply with the request may result in the rejection of its Tender.
- 29.3 Provided that a Tender is substantially responsive, the Employer shall rectify quantifiable nonmaterial nonconformities related to the Tender Price. To this effect, the Tender Price shall be adjusted, for comparison purposes only, to reflect the price of a missing or non-conforming item or component in the manner specified in the **TDS**.

G. Evaluation of Technical Parts of Tenders

30. Evaluation of Technical Parts

30.1 In evaluating the Technical Parts of each Tender, the Employer shall use the criteria and methodologies listed in this ITT and Section III, Evaluation and Qualification Criteria. No other evaluation criteria or methodologies shall be permitted.

30.2 If specified in the **TDS**, the Employer's evaluation will be carried out by applying rated criteria that take into account technical factors, in addition to cost factors. An Evaluated Tender Score will be calculated for each responsive Tender using the formula specified in Section III, Evaluation and Qualification Criteria. The scores to be given to technical factors and sub-factors are specified in the **TDS**. The weights to be given to the cost and the total technical score are specified in the **TDS**.

31. Determination of Responsiveness

31.1 The Employer's determination of a Tender's responsiveness is to be based on the contents of the Tender itself, as defined in ITT 11.

31.2 A substantially responsive Tender is one that meets the requirements of the Tender Document without material deviation, reservation, or omission. A material deviation, reservation, or omission is one that:

(a) if accepted, would:

(i) affect in any substantial way the scope, quality, or performance of the Works specified in the Contract; or

(ii) limit in any substantial way, inconsistent with the Tender Document, the Employer's rights or the Tenderer's obligations under the proposed Contract; or

(b) if rectified, would unfairly affect the competitive position of other Tenderers presenting substantially responsive Tenders.

31.3 The Employer shall examine the technical aspects of the Tender submitted in accordance with ITT 16, in particular, to confirm that all requirements of Section VII, Employer's Requirements have been met without any material deviation, reservation or omission.

31.4 If a Tender is not substantially responsive to the requirements of the Tender Document, it shall be rejected by the Employer and may not subsequently be made responsive by correction of the material deviation, reservation, or omission.

32. Qualification of the Tenderers

- 32.1 The Employer shall determine to its satisfaction whether the eligible Tenderers that have submitted substantially responsive Tender - Technical Parts meet the qualifying criteria specified in Section III, Evaluation and Qualification Criteria.
- 32.2 The determination shall be based upon an examination of the documentary evidence of the Tenderer's qualifications submitted by the Tenderer, pursuant to ITT 17. The determination shall not take into consideration the qualifications of other firms such as the Tenderer's subsidiaries, parent entities, affiliates, subcontractors (other than Specialized Subcontractors if permitted in ITT 33.3), or any other firm(s) different from the Tenderer.
- 32.3 If a Tenderer does not meet the qualifying criteria specified in Section III, Evaluation and Qualification Criteria, its Tender shall be rejected by the Employer and may not subsequently be made responsive by correction of the material deviation, reservation, or omission.
- 32.4 Only Tenders that are both substantially responsive to the Tender Document, and meet all Qualification Criteria shall have their envelopes marked "FINANCIAL PART" opened at the second public opening.

33. Subcontractors

- 33.1 Unless otherwise stated in the **TDS**, the Employer does not intend to execute any specific elements of the Works by subcontractors selected in advance by the Employer.
- 33.2 Tenderers may propose subcontracting up to the percentage of total value of contracts or the volume of works as specified in the **TDS**. Subcontractors proposed by the Tenderer shall be fully qualified for their parts of the Works.
- 33.3 The subcontractor's qualifications shall not be used by the Tenderer to qualify for the Works unless their specialized parts of the Works were previously designated by the Employer in the **TDS** as can be met by subcontractors referred to hereafter as 'Specialized Subcontractors', in which case, the qualifications of the Specialized Subcontractors proposed by the Tenderer may be added to the qualifications of the Tenderer.

H. Public Opening of Financial Parts of Tenders

- 34.1 Following the completion of the evaluation of the Technical Parts of the Tenders, and the Bank has issued its no objection (if applicable), the Employer shall notify in writing those Tenderers whose Tenders

**34. Public Opening
of Financial
Parts**

were considered non-responsive to the Tender Document or failed to meet the Qualification Criteria, advising them of the following information:

- (a) the grounds on which their Technical Part of Tender failed to meet the requirements of the Tender Document;
- (b) their envelopes marked “FINANCIAL PART” will be returned to them unopened after the completion of the selection process and the signing of the Contract; and
- (c) notify them of the date, time and location of the public opening of the envelopes marked “FINANCIAL PART”.

34.2 The Employer shall, simultaneously, notify in writing those Tenderers whose Tenders - Technical Parts have been evaluated as substantially responsive to the Tender Document and met all Qualifying Criteria, advising them of the following information:

- (a) their Tender has been evaluated as substantially responsive to the Tender Document and met the Qualification Criteria;
- (b) When rated criteria are used, the evaluated technical scores;
- (c) their envelope marked “FINANCIAL PART” will be opened at the public opening of the Financial Parts; and
- (d) notify them of the date, time and location of the second public opening of the envelopes marked “FINANCIAL PART” as specified in the **TDS**.

34.3 The opening date should allow Tenderers sufficient time to make arrangements for attending the opening. The Financial Part of the Tender shall be opened publicly in the presence of Tenderers’ designated representatives and anyone who chooses to attend.

34.4 At this public opening the Financial Parts will be opened by the Employer in the presence of Tenderers, or their designated representatives and anyone else who chooses to attend. Tenderers who met the Qualification Criteria and whose Tenders were evaluated as substantially responsive will have their envelopes marked “FINANCIAL PART” opened at the second public opening. Each of these envelopes marked “FINANCIAL PART” shall be inspected to confirm that they have remained sealed and unopened. These envelopes shall then be opened by the Employer. The Employer shall read out the names of each Tenderer, and the total Tender prices, per lot (contract) if applicable, including any discounts and Alternative Tender - Financial Part, and any other details as the Employer may consider appropriate.

- 34.5 Only envelopes of Financial Part of Tenders, Financial Parts of Alternative Tenders and discounts that are opened and read out at tender opening shall be considered further for evaluation. The Letter of Tender – Financial Part and the Priced Bill of Quantities are to be initialed by representatives of the Employer attending the tender opening in the manner specified in the **TDS**.
- 34.6 The Employer shall neither discuss the merits of any Tender nor reject any envelopes marked “FINANCIAL PART”.
- 34.7 The Employer shall prepare a record of the Financial Part of the Tender opening that shall include, as a minimum:
- (a) the name of the Tenderer whose Financial Part was opened;
 - (b) the Tender price, per lot (contract) if applicable, including any discounts; and
 - (c) if applicable, any Alternative Tender – Financial Part.
- 34.8 The Tenderers whose envelopes marked “FINANCIAL PART” have been opened or their representatives who are present shall be requested to sign the record. The omission of a Tenderer’s signature on the record shall not invalidate the contents and effect of the record. A copy of the record shall be distributed to all Tenderers.

I. Evaluation of Financial Parts of Tenders

35. Evaluation of Financial Parts

- 35.1 To evaluate the Financial Part, the Employer shall consider the following:
- (a) the Tender price, excluding Provisional Sums and the provision, if any, for contingencies in the Price Schedule, but including Daywork items, where priced competitively;
 - (b) price adjustment for correction of arithmetic errors in accordance with ITT 36.1;
 - (c) price adjustment due to discounts offered in accordance with ITT 14.4;
 - (d) converting the amount resulting from applying (a) to (c) above, if relevant, to a single currency in accordance with ITT 37;
 - (e) price adjustment due to quantifiable nonmaterial nonconformities in accordance with ITT 29.3; and
 - (f) the additional evaluation factors are specified in the **TDS** and Section III, Evaluation and Qualification Criteria.

35.2 The estimated effect of the price adjustment provisions of the Conditions of Contract, applied over the period of execution of the Contract, shall not be taken into account in Tender evaluation.

35.3 If this Tender Document allows Tenderers to quote separate prices for different lots (contracts), the methodology to determine the lowest evaluated cost of the contract combinations, including any discounts offered in the Letter of Tender – Financial Part, is specified in Section III, Evaluation and Qualification Criteria. If, however, rated criteria are used in accordance with ITT 30.2, discounts on condition of award of more than one contract shall not be used for Tender evaluation purpose.

36. Correction of Arithmetical Errors

36.1 If Tenders have been invited on single responsibility basis in terms of ITT 14, the Tenderer is deemed to have included all prices in the quoted lump sum Tender Price. Arithmetical corrections shall therefore not be made, except that where there is a discrepancy between the amount in words and the amount in figures, the amount in words shall prevail.

36.2 If Tenders have been invited to include any part of the Works to be paid according to quantity supplied or work done in terms of ITT 14, the Employer shall correct arithmetical errors only for the price for such part of the Works on the following basis:

- (a) where there are errors between the total of the amounts given under the column for the price breakdown and the amount given under the Total Price, the former shall prevail and the latter will be corrected accordingly; and
- (b) if there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail subject to (a) above.

36.3 Tenderers shall be requested to accept correction of arithmetical errors. Failure to accept the correction in accordance with ITT 36.1, shall result in the rejection of the Tender.

37. Conversion to Single Currency

37.1 For evaluation and comparison purposes, the currency(ies) of the Tender shall be converted into a single currency as specified in the **TDS**.

- 38. Provision for Development of Domestic Industry** 38.1 Unless otherwise specified in the **TDS**, provision for development of domestic industry (such as a margin of preference for domestic Tenderers¹) shall not apply.
- 39. Comparison of Tenders** 39.1 The Employer shall compare the evaluated costs of all substantially responsive Tenders established in accordance with ITT 35.1 to determine the Tender that has the lowest evaluated cost.
- 39.2 If ITT 30.2 is applicable, the Employer shall evaluate the technical score and financial score of each tender and determine the Tender with the highest combined technical and financial score in accordance with TDS ITT 30.2.
- 40. Abnormally Low-Priced Tenders** 40.1 An Abnormally Low-Priced Tender is one where the Tender price, in combination with other elements of the Tender, appears so low that it raises material concerns as to the capability of the Tenderer in regard to the Tenderer’s ability to perform the Contract for the offered Tender Price.
- 40.2 In the event of identification of a potentially Abnormally Low-Priced Tender, the Employer shall seek written clarifications from the Tenderer, including detailed price analyses of its Tender price in relation to the subject matter of the contract, scope, proposed methodology, schedule, allocation of risks and responsibilities and any other requirements of the Tender Document.
- 40.3 After examining the clarifications given and the detailed price analyses presented by the Tenderer, the Employer may as appropriate:
- (a) accept the Tender, if the evidence provided satisfactorily accounts for the low tender price, in which case the Tender is not considered abnormally low; or
 - (b) accept the Tender, but require that the amount of the Performance Security be increased at the expense of the Tenderer to a level sufficient to protect the Employer against financial loss. The amount of the Performance Security shall generally be not more than 20% of the Contract Price; or

¹An individual firm is considered a domestic Tenderer for purposes of the margin of preference if it is registered in the country of the Employer, has more than 50 percent ownership by nationals of the country of the Employer, and if it does not subcontract more than 10 percent of the contract price, excluding provisional sums, to foreign contractors. JVs are considered as domestic Tenderers and eligible for domestic preference only if the individual member firms are registered in the country of the Employer or have more than 50 percent ownership by nationals of the country of the Employer, and the JV shall be registered in the country of the Employer. The JV shall not subcontract more than 10 percent of the contract price, excluding provisional sums, to foreign firms. JVs between foreign and national firms will not be eligible for domestic preference.

- (c) reject the Tender, if the evidence provided does not satisfactorily account for the low tender price and make a similar determination for the next ranked Tender, if required.
- 41. Unbalanced or Front-Loaded Tenders**
- 41.1 If the Tender that is evaluated as the Most Advantageous Tender is, in the Employer’s opinion, seriously unbalanced or front loaded, the Employer may require the Tenderer to provide written clarifications. Clarifications may include detailed price analyses to demonstrate the consistency of the Tender prices with the scope of works, proposed methodology, schedule and any other requirements of the Tender Document.
- 41.2 After the evaluation of the information and detailed price analyses presented by the Tenderer, the Employer may as appropriate:
- (a) accept the Tender; or
 - (b) accept the Tender, but require that the total amount of the Performance Security be increased at the expense of the Tenderer to a level not exceeding 20% of the Contract Price; or
 - (c) reject the Tender and make a similar determination for the next ranked Tender.
- 42. Most Advantageous Tender**
- 42.1 The Employer shall determine the Most Advantageous Tender. The Most Advantageous Tender is the Tender of the Tenderer that meets the Qualification Criteria and whose Tender has been determined to be substantially responsive to the Tender Documents and:
- (a) when rated criteria are used, is the tender with the highest combined technical and financial score; or
 - (b) when rated criteria are not used, is the tender with the lowest evaluated cost.
- 43. Employer’s Right to Accept Any Tender, and to Reject Any or All Tenders**
- 43.1 The Employer reserves the right to accept or reject any Tender and to annul the Tendering process and reject all Tenders at any time prior to Contract Award, without thereby incurring any liability to Tenderers. In case of annulment, all Tenders submitted and specifically, Tender securities, shall be promptly returned to the Tenderers.
- 44. Standstill Period**
- 44.1 The Contract shall not be awarded earlier than the expiry of the Standstill Period. The Standstill Period shall be ten (10) Business Days unless extended in accordance with ITT 48. The Standstill Period commences the day after the date the Employer has transmitted to each Tenderer the Notification of Intention to Award the Contract. Where only one Tender

is submitted, or if this contract is in response to an emergency situation recognized by the Bank, the Standstill Period shall not apply.

45. Notification of Intention to Award

45.1 The Employer shall send to each Tenderer the Notification of Intention to Award the Contract to the successful Tenderer. The Notification of Intention to Award shall contain, at a minimum, the following information:

- (a) the name and address of the Tenderer submitting the successful Tender;
- (b) the Contract price of the successful Tender;
- (c) the names of all Tenderers who submitted Tenders, and their Tender prices as readout, and as evaluated, and when rated criteria are used, the evaluated technical and financial scores, and the combined total scores;
- (d) a statement of the reason(s) the Tender (of the unsuccessful Tenderer to whom the notification is addressed) was unsuccessful, unless the price or score information in (c) above already reveals the reason;
- (e) the expiry date of the Standstill Period; and
- (f) instructions on how to request a debriefing and/or submit a complaint during the standstill period.

J. Award of Contract

46. Award Criteria

46.1 Subject to ITT 43, the Employer shall award the Contract to the successful Tenderer. This is the Tenderer whose Tender has been determined to be the Most Advantageous Tender.

47. Notification of Award

47.1 Prior to the expiry of the Tender Validity Period and upon expiry of the Standstill Period specified in ITT 43.1 or any extension thereof, and, upon satisfactorily addressing any complaint that has been filed within the Standstill Period, the Employer shall notify the successful Tenderer, in writing, that its Tender has been accepted. The notification of award (hereinafter and in the Conditions of Contract and Contract Forms called the “Letter of Acceptance”) shall specify the sum that the Employer will pay the Contractor in consideration of the execution of the Contract (hereinafter and in the Conditions of Contract and Contract Forms called “the Contract Price”).

47.2 Within ten (10) Business Days after the date of transmission of the Letter of Acceptance, the Employer shall publish the Contract Award Notice which shall contain, at a minimum, the following information:

- (a) name and address of the Employer;
- (b) name and reference number of the contract being awarded, and the procurement method used;
- (c) names of all Tenderers that submitted Tenders, and their Tender prices as read out at Tender opening, and as evaluated, and when rated criteria are used, the evaluated tender scores;
- (d) names of all Tenderers whose Tenders were rejected either as nonresponsive or as not meeting qualification criteria, or were not evaluated, with the reasons therefor;
- (e) the name of the successful Tenderer, the final total contract price, the contract duration and a summary of its scope; and
- (f) successful Tenderer's Beneficial Ownership Disclosure Form, if specified in TDS ITT 49.1.

47.3 The Contract Award Notice shall be published on the Employer's website with free access if available, or in at least one newspaper of national circulation in the Employer's Country, or in the official gazette. The Employer shall also publish the contract award notice in UNDB online and AIIB website.

47.4 Until a formal Contract is prepared and executed, the Letter of Acceptance shall constitute a binding Contract.

48. Debriefing by the Employer

48.1 On receipt of the Employer's Notification of Intention to Award referred to in ITT 44.1, an unsuccessful Tenderer has three (3) Business Days to make a written request to the Employer for a debriefing. The Employer shall provide a debriefing to all unsuccessful Tenderers whose request is received within this deadline.

48.2 Where a request for debriefing is received within the deadline, the Employer shall provide a debriefing within five (5) Business Days, unless the Employer decides, for justifiable reasons, to provide the debriefing outside this timeframe. In that case, the standstill period shall automatically be extended until five (5) Business Days after such debriefing is provided. If more than one debriefing is so delayed, the standstill period shall not end earlier than five (5) Business Days after the last debriefing takes place. The Employer shall promptly inform, by the quickest means available, all Tenderers of the extended standstill period.

48.3 Where a request for debriefing is received by the Employer later than the three (3)-Business Day deadline, the Employer should provide the debriefing as soon as practicable, and normally no later than fifteen (15) Business Days from the date of publication of Contract

Award Notice. Requests for debriefing received outside the three (3)-day deadline shall not lead to extension of the standstill period.

48.4 Debriefings of unsuccessful Tenderers may be done in writing or verbally. The Tenderer shall bear its own costs of attending such a debriefing meeting.

49. Signing of Contract

49.1 The Employer shall send to the successful Tenderer the Letter of Acceptance including the Contract Agreement, and, if specified in the **TDS**, a request to submit the Beneficial Ownership Disclosure Form providing additional information on its beneficial ownership. The Beneficial Ownership Disclosure Form, if so requested, shall be submitted within eight (8) Business Days of receiving this request.

49.2 The successful Tenderer shall sign, date and return to the Employer, the Contract Agreement within twenty-eight (28) days of its receipt.

50. Performance Security

50.1 Within twenty-eight (28) days of the receipt of the Letter of Acceptance from the Employer, the successful Tenderer shall furnish the Performance Security in accordance with the General Conditions of Contract, subject to ITT 40.3 (b) and ITT 41.2 (b), using for that purpose the Performance Security Form included in Section X, Contract Forms, or another form acceptable to the Employer.

50.2 Failure of the successful Tenderer to submit the above-mentioned Performance Security or sign the Contract shall constitute sufficient grounds for the annulment of the award and forfeiture of the Tender Security. In that event the Employer may award the Contract to the Tenderer offering the next Most Advantageous Tender.

51. Procurement Related Complaint

51.1 The procedures for making a Procurement-related Complaint are as specified in the **TDS**.

Section II - Tender Data Sheet (TDS)

The following specific data for the Works to be procured shall complement, supplement, or amend the provisions in the Instructions to Tenderers (ITT). Whenever there is a conflict, the provisions herein shall prevail over those in ITT.

A. General	
ITT 1.1	<p>The reference number of the SPN/Tender is: HORC/HRIDC/SYS-1/2023</p> <p>The Employer is: Haryana Orbital Rail Corporation Limited (HORCL)</p> <p>The name of the Tender is: Contract Package SYS-1: Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km (-) 2.099 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 315 TKM).</p> <p>The number and identification of lots (contracts) comprising this Tender is: Contract Package (SYS-1)</p>
ITT 1.2(a)	<p>Electronic – Procurement System</p> <p>The Employer shall use the following electronic-procurement system to manage this Tendering process:</p> <p>E-procurement portal of Govt. of Haryana (https://etenders.hry.nic.in)</p>
ITT 2.1	<p>The Recipient is: Haryana Orbital Rail Corporation Limited (HORCL) through Government of Haryana</p> <p>The Bank Loan Amount for Part A project - USD 128 million</p> <p>The Bank Loan Amount for Part B project - USD 272 million</p> <p>Total Bank Loan Amount for HORC Project - USD 400 million</p> <p>The name of the Project is: Haryana Orbital Rail Corridor (HORC)</p>
ITT 4.1	<p>Maximum number of members in the JV shall be: Three (03)</p>

ITT 4.1	<p>Add the following after the last sentence of Clause 4.1</p> <p>Highest shareholding member in the JV shall be the Lead member of JV. Minimum percentage share of each JV member shall be as specified in Sub-Clause 3.1.6 of Section III, EQC. No change in constitution or percentage share shall be permitted at any stage after the Tender submission, failing which the Tenderer shall be treated as non-responsive.</p> <p>Authorized Representative of JV shall be from Lead Member of JV.</p>
ITT 4.4	<p>Add the following after the last sentence of Clause 4.4</p> <p>In the event that the Contract is awarded to a foreign Tenderer or to a JV having foreign lead Member, such foreign Tenderer/foreign lead Member shall be required to set up a project office in India in accordance with applicable laws in India, and shall be required to submit a proof of having opened a project office in India along with statutory approvals, if any, prior to submitting any Interim Payment Application in accordance with the Contract, failing which no payment shall be made to the Contractor by the Employer (in accordance with the Contract) until such requirement has been complied with by the foreign Contractor. The aforesaid condition of establishing a project office in India shall not be applicable in case the selected Tenderer is a joint venture between an Indian entity and a foreign entity where Indian Member is lead Member.</p>
ITT 4.5	<p>A list of debarred firms and individuals is available on the Bank's external website: https://www.aiib.org/debarment/</p>
ITT 6.3	<p>Replace ITT 6.3 with the following:</p> <p>The complete Tender Document can be viewed/ downloaded by the Tenderer from e-procurement portal of Govt. of Haryana https://etenders.hry.nic.in. The Employer is not responsible for the completeness of the Tender Document and their addenda, if they were not obtained directly from eProcurement portal of Govt. of Haryana https://etenders.hry.nic.in .</p>
<p>B. Contents of Tender Document</p>	
ITT 7.1	<p>For <u>Clarification of Tender purposes</u> only, the Employer's address is:</p> <p>Attention: GM/IE&A</p> <p>Street address: Haryana Rail Infrastructure Development Corporation Limited (HRIDC), Plot no.143, Railtel Tower, Sector-44</p> <p>Floor: 5th floor</p> <p>City: Gurugram</p> <p>ZIP code: 122003</p> <p>Country: India</p>

	Telephone: +91 8860124749 E-mail: horc.etendering@gmail.com																										
ITT 7.2	Add the following at the end of Para 7.2: <p>The Tenderer must obtain for themselves information related to site conditions, traffic, location, surroundings, climate, hydrology, meteorological conditions, weather data, availability of power, water, other utilities cumulative for construction, access and approach roads to the Site, handling and storage of materials, Waste disposal, applicable laws and regulations and any other matter considered relevant and necessary by them required for submitting their Tender and performance of all of its obligations in accordance with the requirements of Tender Documents.</p> <p>No Site visit will be arranged by the Employer.</p>																										
ITT 7.4	Replace the entire Sub-Clause 7.4 with the following: <p>A Pre-Tender Meeting will take place through online Video conferencing (VC) as well as offline in the Conference room of HRIDC office, Plot No 143, Railtel Tower, Sector-44, Gurugram, Haryana-122003 at the following date and time:</p> <p>Date: 17.06.2023</p> <p>Time: 11.00 hrs. IST</p> <p>The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.</p> <p>The prospective Tenderers who wish to join the Pre-Tender Meeting through VC shall send a request (giving details of the Company, its address, and the name, designation and email of the person attending the VC) through email along with an editable soft copy (MS Word) of the queries raised by them on the email id (i.e.horc.etendering@gmail.com) so that a link for Video Conferencing can be sent by HRIDC. The Tenderers should use the following format for any Pre-Tender queries:</p> <table border="1"> <thead> <tr> <th>Query No.</th> <th>Reference to Tender Document (Clause/ Para No. & Page No.)</th> <th>Brief Description of Clause/ Para No.</th> <th>Query Raised</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td></td> <td></td> <td></td> </tr> <tr> <td>2.</td> <td></td> <td></td> <td></td> </tr> <tr> <td>3.</td> <td></td> <td></td> <td></td> </tr> <tr> <td>4.</td> <td></td> <td></td> <td></td> </tr> <tr> <td>etc.</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>			Query No.	Reference to Tender Document (Clause/ Para No. & Page No.)	Brief Description of Clause/ Para No.	Query Raised	1.				2.				3.				4.				etc.			
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1.																											
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	<p>HRIDC will allow maximum of one email Id for one company to participate in the VC. Any request for VC received after the given date and time for sending the link for VC may not be entertained by HRIDC. Prospective Tenderers will be able to join the VC through the link provided to them on their Email ID.</p>
ITT 7.5	<p>Replace ITT 7.5 with the following:</p> <p>The Tenderer is requested to submit any questions in writing, to reach the Employer not later than 15.06.2023, 18.00 Hrs IST.</p>
ITT 7.6	<p>Replace ITT 7.6 with the following:</p> <p>Minutes of the Pre-Tender Meeting, including the text of the questions raised, without identifying the source, and the responses given, together with any responses prepared after the meeting will be uploaded on e-Procurement portal, https://etenders.hry.nic.in. Any modification to the Tender Document that may in the sole discretion of the Employer become necessary as a result of the Pre-Tender Meeting shall be made by the Employer exclusively through the use of an Addendum/Corrigendum pursuant to ITT 8.</p>
ITT 8.2	<p>Replace ITT 8.2 with the following:</p> <p>Any addendum/Corrigendum issued shall be part of the Tender Document and shall be uploaded on eProcurement portal, https://etenders.hry.nic.in. The onus is on the Tenderers to visit the e-Tendering portal to see the Addenda/Corrigenda published by the Employer.</p>
C. Preparation of Tenders	
ITT 10.1	<p>The language of the Tender is: English</p> <p>All correspondence exchange shall be in English language.</p> <p>Add the following at the end of Sub-Clause ITT 10.1</p> <p>In case the Certificates/ documents other than Power of Attorney are in foreign language, the translation of the same shall be submitted in English language. The translation of Certificates / documents in foreign language shall be done by the licensed translator. Tenderer must submit copy of license issued by the competent authority in their country of origin.</p>

ITT 11.1	<p>Replace ITT 11.1 with the following:</p> <p>The Tenderer shall submit their Tender online on eProcurement portal https://etenders.hry.nic.in as mentioned in para ITT 21.</p> <p>The Tender shall comprise two parts submitted simultaneously, one called the Technical Part containing the documents listed in ITT 11.2 and the other the Financial Part containing the documents listed in ITT 11.3.</p> <p>The Tenderer shall upload only the above mentioned documents in its submission on eProcurement portal. Tenderer is not required to upload Part 1, Part 2 and Part 3 of the Tender document issued by the Employer. The master copy of Tender Document published on eProcurement portal shall be available with HRIDC which shall be final and binding.</p>
ITT 11.2	<p>Replace the entire Sub-Clause 11.2 with the following:</p> <p>The Tenderer shall submit all the documents in its Technical Part as per the Checklist CL (A. Technical Part) given in Section III: Evaluation and Qualification Criteria.</p>
ITT 11.3	<p>Replace the entire Sub-Clause 11.3 with the following</p> <p>The Tenderer shall submit all the documents in its Financial Part as per the Checklist CL (B. Financial Part) given in Section III: Evaluation and Qualification Criteria</p>
ITT 13.1	Alternative Tenders shall not be considered.
ITT 13.2	Alternative times for completion shall not be permitted.
ITT 13.4	Alternative technical solutions shall not be permitted.
ITT 14.2	<p>Replace ITT 14.2 with the following: -</p> <p>The Tenderer shall quote the total lump sum price on “single responsibility basis” for Schedule ‘A’ in the prescribed place of Price Schedule in MS-Excel file.</p> <p>The Tenderer shall quote single percentage (%) Excess (+) or Less (-) on the estimated amount for Sub-Schedule ‘B1’, Sub-Schedule ‘B2’, Sub-Schedule ‘B3’, Sub-Schedule ‘B4’, Sub-Schedule ‘B5’, Sub-Schedule ‘B6’, Sub-Schedule ‘B7’ and Sub-Schedule ‘B8’ in the prescribed place of Price Schedule in MS-Excel file.</p>
ITT 14.4	<p>Replace ITT 14.4 with the following: -</p> <p>As there is no lot in this Contract Package, no discounts shall be quoted by the Tenderers.</p>

ITT 14.7	<p>Replace ITT 14.7 with the following:</p> <p><i>All duties (except Custom Duty), taxes including Goods and Services Taxes (GST), royalties, fees, cess and other levies payable by the Contractor under the Contract, or for any other cause, as of the date 28 days prior to the deadline for submission of Tenders, shall be included in the rates and prices and the total Tender Price submitted by the Tenderer.</i></p> <p><i>The Tenderer must take note of Sub-Clause 14.1, Part B-Specific Provisions, Section IX: Particular Conditions of Contract (PCC) for quoting rates and prices of their Tender.</i></p>
ITT 15.1	<p>The currency(ies) of the Tender and the payment currency(ies) shall be as described below:</p> <p>The prices shall be quoted by the Tenderer in the Price Schedule in Indian Rupees (INR) only. A Tenderer expecting to incur expenditures in other currencies for inputs to the Works supplied from outside the Employer’s Country (referred to as “the foreign currency requirements”) shall indicate in the Appendix A to Financial Part - Table B, Section IV-Tender Forms the percentage(s) of the Tender Price (excluding Provisional Sums), needed by the Tenderer for the payment of such foreign currency requirements, limited to any three freely convertible currencies.</p>
ITT 18.1	<p>The Tender validity period shall be 180 days after the Tender submission deadline date.</p>
ITT 19.1	<p>The Tenderer shall furnish a Tender Security for an amount of INR 10,000,000.00 (INR Ten Million only) or the equivalent amount in a freely convertible currency. The rates of exchange for computing INR equivalent shall be the reference rate prevailing twenty-eight (28) days prior to the deadline of Tender submission. Exchange rates shall be taken from the sources specified in Note No. 1 (iii) given under Sub-Clause 3.4, Section III, EQC.</p>
ITT 19.2	<p>Not Applicable</p>
ITT 19.3	<p>Replace the ITT 19.3 with the following:</p> <p>The amount for Tender Security specified in ITT 19.1 above can be paid online by eligible Tenderers on eProcurement Portal in INR in favour of Haryana Rail Infrastructure Development Corporation Limited using the electronic payment gateway service or Tender Security can be submitted in the form of unconditional and irrevocable Bank Guarantee in INR or the equivalent amount in a freely convertible currency from the specified banks</p>

	<p>using the Tender Security Form included in Section IV, Tender Forms. The Bank Guarantee shall be issued from:</p> <p>(i) a scheduled bank (excluding co-operative banks) in India, or</p> <p>(ii) a Foreign Bank having arrangement with a nationalized bank or scheduled banks (excluding co-operative banks) in India;</p> <p>The scheduled bank issuing the bank guarantee shall be on “Structure Financial Messaging System (SFMS)” platform. A separate advice of the Bank Guarantee shall invariably be sent by the issuing bank to the Employer’s Bank through SFMS and only after receipt of the same by the Employer’s Bank, the bank guarantee shall become operative and acceptable to the Employer. Further, the bank guarantee in original form along with a copy of “MT760COV (in case of bank guarantee message)/ MT767COV (in case of bank guarantee amendment message) Report” sent by the concerned issuing bank sealed in an envelope shall be submitted to the Employer within ten (10) days of deadline of submission of Tender.</p> <p>The Issuing Bank shall send the SFMS to: Beneficiary: Haryana Rail Infrastructure Development Corporation Limited</p> <p>Bank Name: State Bank of India</p> <p>Account Number: 38848977231</p> <p>Branch: SME Branch, Sector 8, Chandigarh</p> <p>IFSC Code: SBIN0011705</p> <p>The Tender Security shall be valid for twenty-eight (28) days beyond the original validity period of the Tender, or beyond any period of extension if requested under ITT 18.2.</p> <p>In case the Tenderer has opted for Tender Security in the form of an unconditional Bank guarantee, the Tenderer shall upload the scanned copy of Bank Guarantee with the Tender. The original Bank Guarantee shall be delivered either by Registered Post/Speed Post/Courier or by hand within ten (10) days of deadline of submission of Tender at the address given below:</p>
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	<p>GM/IE&A, Haryana Rail Infrastructure Development Corporation Limited, Plot No 143, 5th Floor, Railtel Tower, Sector-44, Gurugram, Haryana-122003</p> <p>Non submission of scanned copy of Bank Guarantee with the Tender on eProcurement portal and/or no submission of original Bank Guarantee within the specified period shall lead to summary rejection of Tender. The details of the Original Bank Guarantee should match with the details available in the scanned copy and the data entered during Tender submission time, failing which the Tender shall be rejected.</p> <p>Notes:</p> <ol style="list-style-type: none"> 1. In case SFMS for the Bank Guarantee is not received by the Employer's Bank through SFMS, original copy of BG received in such a manner will be sent to the concerned Bank for its verification and only after its confirmation from the Bank, BG shall be acceptable by the Employer and Tender shall be evaluated. 2. Option of Exemption from payment of EMD mentioned in the module of eProcurement portal is only for exemption of online payment of Tender Security to the Tenderers who wish to submit Tender Security in the form of Bank Guarantee.
ITT 20.1	<p>Replace ITT 20.1 with the following:</p> <p>The Technical Part (comprising of documents specified in ITT 11.2) and Financial Part (comprising of documents specified in ITT 11.3) shall be submitted online on eProcurement portal of Government of Haryana (https://etenders.hry.nic.in) only in accordance with the requirements of the Tender Document.</p>
ITT 20.3	<p>The written confirmation of authorization to sign on behalf of the Tenderer shall consist of:</p> <p>(a) In case of Private/Public Companies, a Power of Attorney from the Director of the Company who has been authorized by the Board of Directors through resolution to sign on behalf of the Company. Copy of Board Resolution shall also be submitted. In case of Foreign Members, Power of Attorney(s) and Board Resolution confirming authority on the persons issuing the Power of Attorney for such actions shall be submitted duly notarized by the notary public of country of origin and should be either stamped by Indian Embassy/High Commission or</p>

	<p>Member Countries of Hague convention may submit these document with “Apostille” stamp.</p> <p>(b) In case of Proprietary Tenderers, Power of Attorney by the Proprietor.</p> <p>(c) In case of Partnership firms, Power of Attorney duly signed by all the Partners.</p> <p>(d) In case of Limited Liability Partnership (LLP) firms, a Power of Attorney issued by the LLP in favour of the individual to sign the tender on behalf of the LLP and create liability against the LLP.</p> <p>(e) In case of Joint Venture, Power of Attorney duly signed by authorized representative of individual Member in favour of the Lead Member and Authorized representative of JV.</p> <p>(f) The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executant(s) and when it is so required the same should be under common seal affixed in accordance with the required procedure.</p>
<p>D. Submission of Tenders</p>	
<p>ITT 21</p>	<p>Replace ITT 21 with the following:</p> <p>21.1 Tenderers shall upload their tender submission online on eProcurement portal (i.e. https://etenders.hry.nic.in) within the stipulated date and time as mentioned in ITT 22.1. The Tenderer shall ensure that they retain a copy of the receipt/ acknowledgement of their Tender submission which is generated by the system upon successful submission of Tender online.</p> <p>21.2 Tenders sent telegraphically or through any other means of transmission except as mentioned above shall be treated as invalid and shall stand rejected.</p> <p>21.3 No details about Financial Part shall be submitted/ disclosed directly or indirectly in the Technical Part failing which the Employer has the right to reject the Tender.</p> <p>21.4 Instructions for Online Tender Submission</p> <p>The Tenderers are required to submit soft copies of their Tenders electronically on the eProcurement portal of Government of Haryana i.e. https://etenders.hry.nic.in, using valid Digital Signature Certificates. The instructions given below are meant to assist the Tenderers in registering on the eProcurement Portal, prepare their</p>

	<p>Tenders in accordance with the requirements and submitting their Tenders online on the eProcurement Portal.</p> <p>Registration:</p> <ol style="list-style-type: none"> i) Tenderers are required to enroll on the above-mentioned eProcurement portal by clicking on the link “Online Bidder Enrollment” on the Portal which is free of charge. ii) As part of the enrolment process, the Tenderers will be required to choose a unique username and assign a password for their accounts. iii) Tenderers are advised to register their valid email address and mobile numbers as part of the registration process. These would be used for any communication from the eProcurement Portal. <p>A. Obtaining a Digital Certificate:</p> <ol style="list-style-type: none"> i. The Tenders submitted online should be encrypted and signed electronically with a Digital Certificate to establish the identity of the Tenderer online. These Digital Certificates are issued by an Approved Certifying Authority, by the Controller of Certifying Authorities, Government of India. ii. A Digital Certificate is issued upon receipt of mandatory identity (i.e. Applicant’s PAN Card) and Address proofs and verification form duly attested by the Bank Manager / Postmaster / Gazetted Officer. Only upon the receipt of the required documents, a digital certificate can be issued. For more details please visit the website – https://etenders.hry.nic.in iii. The Tenderers may obtain Class-II or III digital signature certificate from any Certifying Authority or Sub-certifying Authority authorized by the Controller of Certifying Authorities or may obtain information, application format and documents required for the issue of digital certificate. iv. The Tenderer must ensure that he/she comply by the online available important guidelines at the portal https://etenders.hry.nic.in for Digital Signature Certificate (DSC) including the e-Token carrying DSCs. <p>For any queries related to e-tendering process (registration, online e-bid submission/withdrawal, uploading of documents), Tenderer may contact the below representative of NIC:</p>
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Mr. Anuj Mahajan**E - mail:** amahajan@nic.in, eprocnichry@yahoo.com**Help Desk:** 0120-4001002, 0120-4200462, 0120-4001005, 0120-6277787, 0172-2700275.

- v. Tender for a particular tender must be submitted online using the digital certificate (Encryption & Signing), which is used to encrypt and sign the data during the stage of Tender preparation. In case, during the process of a particular tender, the user loses his digital certificate (due to virus attack, hardware problem, operating system or any other problem) he will not be able to submit the Tender online.

Hence, the users are advised **to keep a backup of the certificate** and also keep the copies at safe place under proper security (for its use in case of emergencies).

- vi. In case of online tendering, if the digital certificate issued to the authorized user of a firm is used for signing and submitting a Tender, it will be considered equivalent to a no-objection certificate/power of attorney/lawful authorization to that User only for accessing eProcurement portal for online Tender submission on the portal. The firm has to authorize a specific individual through an authorization certificate signed by all partners to use the digital certificate as per Indian Information Technology Act 2000. Unless the certificates are revoked, it will be assumed to represent adequate authority of the user to Tender on behalf of the firm in the department tenders as per Information Technology Act 2000. The digital signature of this authorized user will be binding on the firm. This shall in no way relieve the Tenderer from the requirement of submission of Power of Attorney by the Tenderer in terms of ITT 20.3 and ITT 20.4 of Tender Document.
- vii. In case of any change in the authorization, it shall be the responsibility of management/ partners of the firm to inform the certifying authority about the change and to obtain the digital signatures of the new person/ user on behalf of the firm/ company. The procedure for application of a digital certificate however will remain the same for the new user.
- viii. The same procedure holds true for the authorized users in a private/Public limited company. In this case, the authorization certificate will have to be signed by the directors of the company.

B. Opening of an Electronic Payment Account: (Purchase of Tender Document - Online)

For purchasing the Tender Document online, Tenderers are required to pay the Tender Document fee online using the electronic payment gateway service through their Debit Cards & Internet Banking accounts. For online payments guidelines, please refer to the Home page under tab “**Guidelines for hassle free Bid Submission**” of the eProcurement Portal of Government of Haryana, <https://etenders.hry.nic.in>

C. Pre-requisites for online Tendering:

In order to operate on the electronic tender management system, a user’s machine is required to be set up. A help file on system setup/Pre-requisite can be obtained from National Informatics Center or downloaded from the home page of the website - <https://etenders.hry.nic.in> the link for downloading required java applet & DC setup are also available on the Home page of the eProcurement Portal.

D. Online Viewing of Specific Procurement Notice (SPN):

The Tenderers can view the SPN and the time schedule (Key Dates) through the single portal eProcurement system on the Home Page at <https://etenders.hry.nic.in>

E. Downloading of Tender Documents:

The detailed Tender Document can be downloaded free of cost from the eProcurement portal <https://etenders.hry.nic.in> from **02.06.2023 (17:00 Hrs. IST) to 25.08.2023 (15:00 Hrs. IST.)**

F. Key Dates:

The Tenderers are strictly advised to follow dates and times as indicated in the online Specific Procurement Notice. The date and time shall be binding on all Tenderers. All online activities are time tracked and the system enforces time locks that ensure that no activity or transaction can take place outside the start and end dates and the time of the stage as defined in the online Specific Procurement Notice.

G. Online Payment of E-Service Fee & Tender Security:

The online payment for E-Service Fee and Tender Security in INR or equivalent amount in a freely convertible currency shall be made using the secure electronic payment gateway by Tenderers online directly through Debit Cards & Internet Banking accounts.

The secure electronic payments gateway is an online interface between Contractors and Debit card/online payment authorization networks.

H. Offline Payment of Tender Security

For submission of the Tender Security in the form of BG (Tender Security offline Payment), System will direct Tenderer to the EMD details page (EMD Payment offline). Following Steps are to be followed:

Step 1: Select 'Yes' option where system asks "Are you submitting EMD through BG/ST or Exempted from EMD payment".

Step 2: Select 'Percentage' option to choose EMD exemption type and insert 100% as exemption.

Step 3: Tenderer must upload scanned copy of Bank Guarantee as EMD exemption document on e-Procurement Portal. After uploading the document, Tenderer must sign the document digitally.

Step 4: After confirming the details of payment, Tenderer must Select option "Confirm to pay"

Step 5: Tenderer must enter the details of BG as EMD fee detail on EMD offline payment page.

Note: Option of Exemption from payment of EMD mentioned in the module of eProcurement portal is only for exemption of online payment of Tender Security to the Tenderers who wish to submit Tender Security in the form of Bank Guarantee.

I. Preparation & Submission of online Applications/Tenders:

i. Tender shall mandatorily be submitted online following the instruction appearing on the screen.

ii. **Scan copy of Documents to be submitted/uploaded for Technical Part under online PQQ/ Technical Envelope:**

All documents shall be prepared and scanned in file formats PDF /JPEG/MS WORD format such that file size does not exceed 10 MB)

	<p>and uploaded during the online submission of PQQ or Technical Envelope.</p> <p>iii. FINANCIAL PART (MS-Excel File for quoting price and Pdf file for Letter of Tender-Financial Part and Appendix A and Appendix B to Letter of Tender- Financial Part) shall be submitted mandatorily online under Commercial Envelope and original not to be submitted manually.</p> <p>NOTES:</p> <p>(A) <i>Tenderers participating in online tenders shall check the validity of his/her Digital Signature Certificate before participating in the online Tenders at the portal https://etenders.hry.nic.in.</i></p> <p>(B) <i>For help manual, please refer to the ‘Home Page’ of the eProcurement website at https://etenders.hry.nic.in.</i></p>
ITT 22.1	<p>Replace ITT 22.1 with the following:</p> <p>The Tender submission is through the eProcurement portal only (i.e. https://etenders.hry.nic.in) as specified in ITT 21.1</p> <p>The Tenderer shall submit its Tender before expiry of the date and time for tender submission as specified herein.</p> <p>The start date for Tender submission is:</p> <p>Date: <i>17.08.2023</i></p> <p>Time: 1100 hrs. IST</p> <p>The deadline for Tender submission is:</p> <p>Date: <i>25.08.2023</i></p> <p>Time: 1500 hrs. IST</p>
ITT 23.1	<p>Replace ITT 23.1 with the following:</p> <p>Submission of Tenders shall be closed on eProcurement portal on the date & time of submission as prescribed in ITT 22.1 after which no tender can be uploaded.</p>
ITT 24	<p>Replace ITT 24 with the following:</p> <p>24.1 The Tenderer may modify, substitute or withdraw its e-Tender after submission prior to the deadline for submission of Tenders. For modification</p>

	<p>of e-Tender, Tenderer has to detach its old Tender from eProcurement portal (https://etenders.hry.nic.in) and upload/ resubmit digitally signed modified tender. For withdrawal of tender, Tenderer has to click on withdrawal icon at e- procurement portal and can withdraw its e-tender. Before withdrawal of a tender, it may specifically be noted that after withdrawal of a tender for any reason, Tenderer cannot re-submit e-tender again.</p> <p>24.2 No Tender may be withdrawn, substituted, or modified in the interval between the deadline for submission of Tenders and the expiration of the period of Tender validity specified on the Letter of Tender or any extension thereof.</p>
<p>E. Public Opening of Technical Parts of Tenders</p>	
<p>ITT 25</p>	<p>Replace ITT 25 with the following:</p> <p>25.1 The Employer shall conduct the electronic opening of Technical Part on eProcurement portal on the date, time and place as specified below:</p> <p>Street Address: Haryana Rail Infrastructure Development Corporation Limited (HRIDC), Plot no.143, Railtel Tower, Sector-44</p> <p>Floor/ Room number: 5th floor</p> <p>City: Gurugram</p> <p>Zip code: 122003</p> <p>Country: INDIA</p> <p>Date: 25.08.2023</p> <p>Time: 1530 hrs IST</p> <p>The opening of the Technical Part and subsequent details can be viewed by the Tenderers by logging on the eProcurement portal. Alternatively, any Tenderer who wish to attend the Technical Part opening can be present during the opening. The Tenderer’s representatives who are present shall be requested to mark their attendance on the format available with the Employer.</p> <p>25.2 The Financial Part submitted online on eProcurement portal will remain unopened in the eProcurement portal until the date and time of opening of Financial Part. The date and time of the opening of the Financial Part will be notified to all the Tenderers on eProcurement portal whose tender is found</p>

	<p>to be substantially responsive and qualified in technical evaluation as specified in ITT 34.2.</p> <p>25.3 At the time of opening of Technical Part, the following shall be read out and recorded:</p> <ul style="list-style-type: none"> (a) the name of the Tenderer; (b) the presence of a Tender Security; and (c) any other details as the Employer may consider appropriate. <p>Only Technical Part read out and recorded at Tender opening shall be considered for evaluation.</p> <p>25.4 The Employer shall prepare a record of the opening of Technical Part that shall include, as a minimum, the name of the Tenderer and the presence or absence of Tender Security. The Tenderer's representatives who are present shall be requested to sign the record available with the HRIDC. The omission of a Tenderer's signature on the record shall not invalidate the contents and effect of the record.</p> <p>25.5 At the Tender opening the Employer shall neither discuss the merits of any Tender nor reject any Tender.</p>
<p>F. Evaluation of Tenders – General Provisions</p>	
<p>ITT 27</p>	<p>Replace ITT 27 with the following:</p> <p>27.1 To assist in the examination, evaluation and comparison of the Tenders, the Employer may, at its discretion, ask any Tenderer for a clarification of its Tender in accordance with ITT Clause 29. Any clarification submitted by a Tenderer that is not in response to a request by the Employer shall not be considered. The Employer's request for clarification and the response shall be in writing and delivered to concerned Tenderers (by courier or e-mail through PDF attachment). The due date and time to respond to these queries will also be communicated. No change in the prices or substance of the Tender shall be sought, offered, or permitted, except to confirm the correction of errors discovered by the Employer in the evaluation of the Financial Part, in accordance with ITT Clause 35.</p>

	27.2 If a Tenderer does not provide clarifications of its Tender by the date and time set in the Employer’s request for clarification, their Tender shall be evaluated as per the available information in the submitted Tender.
ITT 29.3	Not Applicable
G. Evaluation of Technical Parts of Tenders	
ITT 30.2	Not Applicable
ITT 32.4	<p>Replace ITT 32.4 with the following:</p> <p>Only Tenders that are both substantially responsive to the Tender Document, and meet all Qualification Criteria, shall be notified on eProcurement portal for the public opening of “FINANCIAL PART”.</p>
ITT 33.1	Subcontractor is permitted for the activity specified in ITT 33.3.
ITT 33.2	Maximum allowable accumulated value of work to be subcontracted (as a percentage of the Accepted Contract Amount)- 10%
ITT 33.3	Specialist Subcontractor meeting the qualification requirement specified in Appendix -13: Subcontractor for ROCS System, Section VII-1: General Specifications (GS), Part 2 Employer’s Requirements is permitted for Rigid Overhead Conductor Systems (ROCS) works.
H. Public Opening of Financial Parts of Tenders	
ITT 34	<p>Replace ITT 34 with the following:</p> <p>34.1 Following the completion of the evaluation of the Technical Parts of the Tenders, and the Bank has issued its no objection, the Employer shall notify in writing those Tenderers whose Tenders were considered non-responsive to the Tender Document or failed to meet the Qualification Criteria, advising them of the following information:</p> <ul style="list-style-type: none"> (a) the grounds on which their Technical Part of Tender failed to meet the requirements of the Tender Document; (b) their “FINANCIAL PART” shall remain unopened on the eProcurement portal; (c) notify them of the date, time and location of the public opening of “FINANCIAL PART” on the eProcurement portal;

	<p>34.2 The Employer shall, simultaneously, notify in writing those Tenderers whose Tenders - Technical Parts have been evaluated as substantially responsive to the Tender Document and met all Qualifying Criteria, advising them of the following information:</p> <ul style="list-style-type: none"> (a) their Tender has been evaluated as substantially responsive to the Tender Document requirements and met the Qualification Criteria; (b) their “FINANCIAL PART” on eProcurement portal will be opened at the public opening of the Financial Parts; and (c) notify them of the date, time and location of the public opening of the “FINANCIAL PART” as specified below: <ul style="list-style-type: none"> i. The Employer shall publish a notice of the public opening of the Financial Parts on eProcurement portal. ii. Any interested party who wishes to attend this public opening may contact: <p>For the attention: GM/IE&A Haryana Rail Infrastructure Development Corporation Limited</p> <p>Email address: horc.etendering@gmail.com</p> <p>34.3 The “FINANCIAL PART” of Tenderers who met the Qualification Criteria and whose Tenders were evaluated as substantially responsive, will be opened on eProcurement portal. The Employer shall read out the names of each Tenderer, and the total Tender prices, including any discounts and any other details as the Employer may consider appropriate.</p> <p>34.4 The Employer shall neither discuss with Tenderer’s representative present, if any, the merits of any Tender nor reject any “FINANCIAL PART”.</p> <p>34.5 The Employer shall prepare a record of the Financial Part of the Tender opening that shall include, as a minimum:</p> <ul style="list-style-type: none"> (a) the name of the Tenderer whose Financial Part was opened; and (b) the Tender price <p>34.6 The Tenderer’s representatives who are present at the time of opening of Financial Part shall be requested to sign the record. The omission of a Tenderer’s signature on the record shall not invalidate the contents and effect of the record. A copy of the record (i.e. summary of rates quoted) can be viewed by all eligible Tenderers after opening of the Financial Part.</p>
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I. Evaluation of Financial Parts of Tenders	
ITT 37.1	The currency that shall be used for tender evaluation and comparison purposes is Indian Rupees (INR) only .
ITT 38.1	Provisions for development of domestic industry (such as a margin of domestic preference) shall not apply.
J. Award of Contract	
ITT 47.1	<p>Add the following to ITT 47.1</p> <p>The Accepted Contract Amount shall be in INR only. However, the payments will be made in currencies as quoted by the Tenderer in Appendix A, Table B, Section IV-Tender Forms.</p>
ITT 49.1	The successful Tenderer shall submit the Beneficial Ownership Disclosure Form.
ITT 51.1	<p>The procedures for making a Procurement-related Complaint are detailed in the Bank's <u>Procurement Instructions for Recipients</u> (Annex IV). A Tenderer may make a Complaint in writing, to:</p> <p style="padding-left: 40px;">For the attention: GM/IE&A</p> <p style="padding-left: 40px;">Haryana Rail Infrastructure Development Corporation Limited</p> <p style="padding-left: 40px;">Email address: <u><i>horc.etendering@gmail.com</i></u></p>

Section III. Evaluation and Qualification Criteria

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1. General Provisions

1.1 Evaluation Sequence

- (a) Tenders will be evaluated through the following four stages:
 - (i) Stage 1: Evaluation of Administrative Requirements
 - (ii) Stage 2: Evaluation of Compliance with the Qualification Requirements
 - (iii) Stage 3: Technical Evaluation
 - (iv) Stage 4: Financial Evaluation

1.2 Clarification from Tenderers

- (a) The Evaluation Team may request clarification(s) of any Tender in accordance with the provisions of the Tender Documents (Part 1, Section-I: Instructions to Tenderers, Clause 27 and Clause 29).
- (b) If clarification is required, the Evaluation Team will send written (Courier/email with PDF attachment) request(s) to the Authorized Representative for clarification(s), specifying the deadline for receipt of reply.
- (c) Replies to the above request(s) shall be sent by Tenderer through Courier/e-mail with PDF attachments and the same shall be solely to clarify and/or elaborate the item(s) already included in the submitted Tenders for the purpose of evaluation in accordance with ITT 27.1 and ITT 29.

1.3 Tender Forms

- (a) Tenderers should note that the information required to be inserted into the Tender Forms shall be comprehensive and detailed. The technical information shall be furnished in line with the requirements of Part 1, Part 2 and Part 3 of the Tender Documents.
- (b) All Forms contained in the Tender Documents must be fully and properly completed and all the forms must be returned duly signed by Authorized Representative of the Tenderer, as they will be reviewed exactly as submitted and errors or omissions may count against the Tenderer.
- (c) Any Tenderer who is found to have intentionally submitted false or inaccurate statements/information shall be disqualified from the Tendering process.

2. Stages of Evaluation

2.1 Stage 1: Evaluation of Administrative Requirements

A. General

- (a) The Stage 1 Evaluation will consist of checking the Tenders to confirm whether they are substantially responsive to the administrative requirements of the Tender Documents.
- (b) The following administrative items will be checked:
 - (i) Whether the Tender submission is in accordance with ITT 11.2;
 - (ii) Whether the Power of Attorney (POA) for the Tender signatory is in the correct form [Ref. ITT 20.3 and ITT 20.4]. If during technical evaluation stage, POA submitted by the Tenderer is not found in the correct format, Employer will send written (Courier/email with PDF attachment) request to the Authorized Representative for rectification of POA in accordance with format prescribed in Section IV, Tender Forms, specifying the deadline for receipt of Power of Attorney in correct form. If a tenderer does not provide the Power of Attorney in correct form within the stated date and time set in the Employer's request for correction of Power of Attorney, its Tender is liable to be rejected.

2.2 Stage 2: Evaluation of Compliance with the Qualification Requirements

A. General

Tenders will be reviewed to ascertain whether the Tender complies with all of the minimum requirements as stipulated in the Sub-Clause C. Qualification Criteria.

B. Check Items

The following requirements of the Instruction to Tenderers, Clauses 4, 11 & 17 will be checked to ensure compliance to the requirements of criteria given below:

- (a) **Eligibility**
 - (i) Nationality: Form ELI-1.1(a), ELI-1.1(b), and Form ELI-1.2
 - (ii) Conflict Interest: Letter of Tender-Technical Part
 - (iii) Bank Eligibility: Letter of Tender -Technical Part
 - (iv) State-owned Enterprise or Institution of the Recipient country: Form ELI-1.1(a), ELI-1.1(b), and Form ELI-1.2, Letter of Tender -Technical Part
 - (v) United Nations resolution or Recipient's country law: Letter of Tender-Technical Part
- (b) **Historical Contract Non-Performance and Litigation**
 - (i) History of Non-Performing Contracts: Form CON-1
 - (ii) Suspension Based on Execution of Tender- Securing Declaration by the Employer: Letter of Tender-Technical Part
 - (iii) Pending Litigation: Form CON-1
 - (iv) Declaration: Environmental, Social, Health, and Safety (ESHS) past performance: Form CON-2
- (c) **Financial Situation**
 - (i) Financial Situation and Performance: Form FIN-3.3.1
 - (ii) Average Annual Construction Turnover: Form FIN-3.3.2
 - (iii) Bid Capacity: Form FIN 3.3.4
- (d) **Financial Resources**
 - (i) Financial Resources: Form FIN-3.3.3
 - (ii) Average Net Worth and Net Worth: Form FIN 3.3.1
- (e) **Experience**
 - (i) General Construction Experience: Form EXP-3.4.1
 - (ii) Specific Construction and Contract Management Experience: Form EXP-3.4.2(a)
 - (iii) *Specific Construction Experience in Key Activities: Form EXP 3.4.2 (b) (i) and: Form EXP 3.4.2 (b) (ii)*

3. Qualification Criteria

If the Tenderer fails to comply with any item of Qualification Criteria given below, the Tenderer shall be disqualified.

No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Members Combined	Each Member	Lead Member	
3.1 Eligibility							
3.1.1	Nationality	Nationality in accordance with ITT 4.4	Must meet requirement	Must meet requirement	Must meet requirement	Must meet requirement	Forms ELI – 1.1 (a), ELI – 1.1 (b) and ELI-1.2 with attachments
3.1.2	Conflict of Interest	No conflicts of interest in accordance with ITT 4.2	Must meet requirement	Must meet requirement	Must meet requirement	Must meet requirement	Letter of Tender-Technical Part
3.1.3	Bank Eligibility	Not having been declared ineligible by the Bank, as described in ITT 4.5.	Must meet requirement	Must meet requirement	Must meet requirement	Must meet requirement	Letter of Tender-Technical Part
3.1.4	State-owned Enterprise or Institution of the Recipient country	Meets conditions of ITT 4.6	Must meet requirement	Must meet requirement	Must meet requirement	Must meet requirement	Letter of Tender-Technical Part and Form ELI – 1.1 (a), ELI – 1.1 (b) and ELI-1.2 with attachments

No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Members Combined	Each Member	Lead Member	
3.1.5	United Nations resolution or Recipient's country law	Not having been excluded as a result of prohibition in the Recipient's country laws or official regulations against commercial relations with the Tenderer's country, or by an act of compliance with UN Security Council resolution, both in accordance with ITT 4.8 and Section V.	Must meet requirement	Must meet requirement	Must meet requirement	Must meet requirement	Letter of Tender-Technical Part
3.1.6	Share of JV members	The share of JV members shall not be less than the specified percentage.	N/A	100%	30%	34%	Form ELI-1.3
3.2 Historical Contract Non-Performance							
3.2.1	History of Non-Performing Contracts	Non-performance of a contract ² did not occur as a result of contractor default since 1 st April 2018 till 28	Must meet requirement	Must meet requirement	Must meet requirement ³	Must meet requirement	Form CON-1

² Nonperformance, as decided by the Employer, shall include all contracts terminated by the Employer where (a) nonperformance was not challenged by the contractor, including through referral to the dispute resolution mechanism under the respective contract, and (b) contracts that were so challenged but fully settled against the contractor. Nonperformance shall not include contracts where Employer's decision was overruled by the dispute resolution mechanism. Nonperformance must be based on all information on fully settled disputes or litigation, i.e., dispute or litigation that has been resolved in accordance with the dispute resolution mechanism under the respective contract and where all appeal instances available to the Tenderer have been exhausted.

³ This requirement also applies to contracts executed by the Tenderer as JV member.

No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Members Combined	Each Member	Lead Member	
		days prior to deadline of Tender submission.					
3.2.2	Suspension Based on Execution of Tender-Securing Declaration by the Employer	Not under suspension based on-execution of a Tender/Proposal Securing Declaration pursuant to ITT 4.7 and ITT 19.9	Must meet requirement	Must meet requirement	Must meet requirement	Must meet requirement	Letter of Tender – Technical Part
3.2.3	Pending Litigation	Tenderer's financial position and prospective long-term profitability still sound according to criteria established in 3.3.1 (ii) below and assuming that all pending litigation and arbitration ⁴ will be resolved against the Tenderer.	Must meet requirement	N/A	Must meet requirement	Must meet requirement	Form CON-1
3.2.4	Declaration: Litigation History	Declare History of court/arbitral award decisions against the Tenderer since 1st April 2018 till 28 days prior to	Must make the declaration	N/A	Must make the declaration	Must make the declaration	Form CON-1

⁴ The Tenderer shall provide accurate information in the Tender Form CON-1 about any litigation and arbitration resulting from contracts completed or ongoing under its execution over the last five years since 1st April 2018 till 28 days prior to deadline of Tender submission.

No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Members Combined	Each Member	Lead Member	
		deadline of Tender submission.					
3.2.5	Declaration: Environmental, Social, Health, and Safety (ESHS) past performance	Declare any civil work contracts that have been suspended or terminated and/or performance security called by an employer for reasons related to the non-compliance of any environmental, or social, or health, or safety requirements or safeguard in the past five years ⁵ preceding 28 days prior to deadline of Tender submission	Must make the declaration	N/A	Must make the declaration	Must make the declaration	Form CON-2 ESHS Performance Declaration
3.3 Financial Situation and Performance							
3.3.1	Financial Capabilities	i) The Tenderer shall demonstrate that it has access to, or has available, liquid assets, unencumbered real assets, lines of credit, and other	Must meet requirement	Must meet requirement	Must meet at least 30% [Thirty percentage] of requirement	Must meet at least 40% [Forty percentage] of requirement	Form FIN-3.3.3 (Sources of Finance for the subject Contract)

⁵The Employer may use this information to seek further information or clarifications in carrying out its due diligence.

No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Members Combined	Each Member	Lead Member	
		financial means (independent of any contractual advance payment) sufficient to meet the construction cash flow requirements estimated as INR 200 million or the equivalent amount in a freely convertible currency for the subject contract (i.e. SYS-1).					
		(ii) The Tenderer must demonstrate the current soundness of its financial position and indicate its prospective long-term profitability. As a minimum, a) Average Net-Worth (Total Assets – Total Liabilities)* during the last three (03) financial years should be positive and b) the Net-Worth during the last financial year must be positive .	Must meet requirement	Must meet requirement	Must meet requirement	Must meet requirement	Form FIN-3.3.1

No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Members Combined	Each Member	Lead Member	
		<p>*Note: Amount in dispute against the Tenderer corresponding to all pending litigations and arbitration resulting from contracts completed or ongoing under its execution over the last five years, considering that these will be resolved against the Tenderer (as per Form CON-1 item 2 and 3), will be subtracted from the Average Net Worth calculated above.</p>					
3.3.2	Average Annual Construction Turnover	Minimum average annual construction turnover of INR 1800 million or the equivalent amount in a freely convertible currency calculated as total certified payments received for contracts in progress and/or completed within the last three financial years divided by three.	Must meet requirement	Must meet requirement	Must meet 30% <i>[Thirty percentage]</i> of the requirement	Must meet 40% <i>[Forty percentage]</i> of the requirement	Form FIN-3.3.2

No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Members Combined	Each Member	Lead Member	
3.3.3	Bid Capacity	<p>The Tenderer shall also demonstrate to the satisfaction of the Employer, that it has adequate Bid capacity for the works currently in progress and future contract commitments.</p> <p>The available Bid capacity should be equal to or more than INR 5000 million or the equivalent amount in a freely convertible currency. The available Bid capacity will be calculated as per item no. 1 of Form FIN-3.3.4.</p>	Must meet requirement	Must meet requirement	Must meet at least 30% [<i>Thirty percentage</i>] of requirement	Must meet at least 40% [<i>Forty percentage</i>] of the requirement	Form FIN – 3.3.2 & Form FIN- 3.3.4
3.4 Experience							
3.4.1	General Construction Experience	Experience under infrastructure contracts involving electrical works in the role of Prime Contractor, JV Member or Management Contractor or a Sub-Contractor starting	Must meet requirement	N/A	Must meet requirement	Must meet requirement	Form EXP-3.4.1

No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Members Combined	Each Member	Lead Member	
		1 st April 2016 till 28 days prior to deadline of Tender submission.					
3.4.2 (a)	Specific Construction & Contract Management Experience	Participation, as a Prime Contractor, Joint venture ⁶ Member or Management Contractor ⁷ or Sub-Contractor ⁸ in at least (i) One “similar work” of minimum value of INR 3000.00 million or the equivalent amount in	Must meet requirement of either (i) or (ii) or (iii)	Must meet requirement of either (i) or (ii) or (iii)	Must have the experience of execution of at least one “similar work” of minimum value of INR 1500.00 million or equivalent amount in any	Must have the experience of execution of at least one “similar work” of minimum value of INR 1500.00 million or equivalent amount in any	Form EXP-3.4.2 (a)

⁶ Value of completed work done by a Member in an earlier JV shall be reckoned only to the extent of the concerned member’s share in that JV for purpose of satisfying his/her experience criteria mentioned in 3.4.2(a).

⁷ A management contractor is a firm which takes on the role of contract management as a “general” contractor of sort could do. It does not normally perform directly the work(s) associated with the Contract. Rather, it manages the work of other Contractors/Sub-Contractors while bearing full responsibility for quality, and timely performance of the contract. If the Tenderer or any of the JV member submits experience certificate as a Management Contractor, then the documents issued by the Employer (owner of the work) /*Independent Engineer/Concessionaire* in support of his being appointed as Management Contractor shall only be considered for evaluation and qualification purpose. In case the Tenderer fails to submit such document(s) issued by the Employer (owner of the work) /*Independent Engineer/Concessionaire*, the offer of the Tenderer shall be summarily rejected.

⁸ If a tenderer has successfully completed a work as Sub-Contractor, the work experience certificate issued only by the Employer (owner of the work) /*Independent Engineer/Concessionaire* for such work to Sub-Contractor shall be considered for the purpose of fulfillment of credentials. Tenders submitted without this documentary proof shall be summarily rejected.

For example: Entity ‘A’ is the owner of the work and awards a contract ‘A’ for execution of work to Contractor ‘X’. Thereafter, Contractor ‘X’ sublets part of the work to Sub-Contractor ‘Y’. In this case, experience certificate of Sub-Contractor ‘Y’ issued by Entity ‘A’ /*Independent Engineer/Concessionaire* shall be considered for the purpose of evaluation of the Tender. Experience certificate issued by Contractor ‘X’ to Sub-Contractor ‘Y’ shall not be considered and the offer submitted based on such certificate shall be summarily rejected.

No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Members Combined	Each Member	Lead Member	
		<p>a freely convertible currency.</p> <p>OR</p> <p>(ii) Two “similar works” each of minimum value of INR 2000.00 million or the equivalent amount in a freely convertible currency.</p> <p>OR</p> <p>(iii) Three “similar works” each of minimum value of INR 1500.00 million or the equivalent amount in a freely convertible currency.</p> <p>The works mentioned in (i), (ii) and (iii) above must have been successfully completed or substantially</p>			<p>freely convertible foreign currency.</p> <p>The above work must have been successfully completed or substantially completed¹⁰ since 1st April 2016 till 28 days prior to deadline of Tender submission.</p>	<p>freely convertible foreign currency.</p> <p>The above work must have been successfully completed or substantially completed¹⁰ since 1st April 2016 till 28 days prior to deadline of Tender submission.</p>	

No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Members Combined	Each Member	Lead Member	
		<p>completed⁹ since 1st April 2016 till 28 days prior to deadline of Tender submission and that are similar to the proposed works.</p> <p>“Similar Work” shall be “Railway Project”¹⁰ involving supply, installation, testing & commissioning of 1 x 25kV / 2 x 25kV Overhead Electrification (OHE) Works/Traction Substation (TSS).</p>					
3.4.2 (b)	Specific Construction Experience in Key Activities	<p>Participation, as a Prime Contractor, Joint Venture member or Management Contractor or Sub-Contractor:</p> <p>(i) of having completed supply, installation, testing</p>	Must meet requirement of (i) AND (ii)	Must meet requirement of (i) AND (ii)	Must meet requirement of either (i) OR (ii)	Must meet requirement of either (i) OR (ii)	Form EXP-3.4.2 (b)

⁹ Substantial completion shall be based on 80% or more of the original value of works completed under the contract. Completion/Substantial completion of works shall be based on Completion Certificate /Provisional Completion Certificate/Provisional Acceptance Certificate (PAC) issued by the Employer (owner of the Work)/Independent Engineer/*Concessionaire*.

¹⁰ “Railway Projects” includes projects of Railway/ Metro Rail/ RRTS/High Speed Rail/*Dedicated Freight Corridor (DFC)*.

No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Members Combined	Each Member	Lead Member	
		<p>& commissioning of 1 x 25kV/2x25kV, Overhead Electrification (OHE) works of minimum</p> <p>a) 110 TKM in one contract</p> <p style="text-align: center;">OR</p> <p>b) 145 TKM in two contracts combined together</p> <p style="text-align: center;">OR</p> <p>c) 165 TKM in three contracts combined together</p> <p>The above key activity should be completed in Railway / Metro Rail / RRTS / High Speed Rail/DFC projects.</p> <p style="text-align: center;">And</p> <p>(ii) Must have completed supply, installation, testing & commissioning of minimum One (01)</p>					

No.	Subject	Requirement	Single Entity	Joint Venture (existing or intended)			Submission Requirements
				All Members Combined	Each Member	Lead Member	
		<p>Traction Substation (TSS) of 1 x 25kV/ 2 x 25kV in One contract (either in any of the works under (i) (a), (i) b and (i) c mentioned above OR in a separate contract.) for Railway / Metro Rail / RRTS / High Speed Rail/DFC projects.</p> <p>The key activity mentioned in (i) and (ii) above should have been executed in completed/ongoing contracts¹¹. The contracts for completed works must have been completed between 1st April 2016 and 28 days prior to deadline of Tender submission.</p>					

¹¹ OHE/TSS works in completed/ongoing contracts shall be considered only if Completion Certificate/Provisional Completion Certificate/Provisional Acceptance Certificate (PAC) has been issued by the Employer/Independent Engineer/Concessionaire for the quantities specified in Sub-Clause 3.4.2 (b) above.

Notes:**1. Exchange Rate for Qualification Criteria**

Wherever a Form in Section IV, Tender Forms, requires a Tenderer to state a monetary amount, Tenderers shall indicate the INR equivalent as indicated in the respective form using the rate of exchange determined as follows:

- (i) For construction turnover or financial data required for each year – Exchange rate prevailing on the last day of the respective financial year.
 - (ii) Value of single contract - Exchange rate prevailing on the date of the Contract Award i.e. the date of issue of Letter of Acceptance.
 - (iii) Exchange rates shall be taken from reference rate published by the Reserve Bank of India (RBI) on its website <https://www.rbi.org.in>. In case the exchange rate of particular currency on given date is not available on RBI web site, it will be as per the web site <https://www.fbil.org.in> of Financial Benchmark India Private Limited (FBIL). Any error in determining the exchange rates may be corrected by the Employer. In the case, where a Tenderer is required to convert a monetary amount from a currency other than those currencies for which the RBI/FBIL reference rate is not published, the INR equivalent shall be worked out using the rate of exchange as published by the central bank of the country issuing the said currency. In case the exchange rate of that currency is not directly available in INR on the website of the central bank of the country issuing the said currency then the currency will be first converted to USD as per that web site and then converted from USD to INR as Per RBI or FBIL reference rates.
2. Value of completed work done by a Member in an earlier JV shall be reckoned only to the extent of the concerned member's share in that JV for purpose of satisfying his/her experience criteria mentioned in 3.4.2(a).
 3. For past experience of a firm in earlier JV for specified key activity in sub clause 3.4.2 (b) credit shall be given for execution of only the quantity executed by the firm as part of a JV, duly certified by the Employer. If the Employer's Certificate does not indicate the quantity of specified key activity executed by each member, in such a case credit for quantity of specified key activity shall be given as per following provisions in order of priority:
 - (i) As per details given in JV agreement forming part of the relevant Contract Agreement.

- (ii) *If JV agreement does not provide such details, then credit shall be given in proportion of the percentage share of the firm in that JV mentioned in the Employer's Certificate/ JV Agreement.*
4. *In case a JV quoting for the Tender has executed similar work specified in Sub-Clause 3.4.2(a) and key activity specified in Sub-Clause 3.4.2 (b) with the same constitution of JV, the requirement specified to be met under Sub-Clause 3.4.2(a) and Sub-Clause 3.4.2 (b) shall be considered to have been met treating the JV as a single entity for this purpose.*
5. *For Sub-Clause 3.3.2, Average Annual Construction Turnover, the Tenderer should submit actual construction turnover figures for the specified financial years. For Evaluation purposes the figures of previous years shall be updated @ 5% per year compounded annually based on Rupee value to bring them to the level of the last Financial Year specified in Sub-Clause 3.3.2. If the figure for turnover in an individual year is in a currency other than INR, then the same shall first be converted to INR based on the exchange rates derived as mentioned in Note 1 above and then the figures in INR shall be updated.*
6. *For Sub-Clause 3.4.2 (a) Specific Construction & Contract Management Experience, the Tenderer should submit actual Value of Work completed/ substantially completed. Value of Work for Evaluation purposes shall be updated @ 5% per year compounded annually based on Rupee value to bring them to the price level of date of deadline for submission of Tenders. Updated value shall be calculated as per formula given below:-*

$$A = Bx [1.05]^{N/365}$$

Where

A = updated value of work on deadline for submission of Tenders.

B = value of work on the date of completion/substantial completion as indicated in the Employer's certificate.

N = Number of days between date of completion and deadline for submission of Tenders.

Stage 3: Technical Evaluation

A. Procedure for Technical Evaluation

- (a) The Stage 3 Evaluation will consist of checking the technical aspects of the Tenders to confirm whether they substantially conform to the requirements of the Tender Document.
- (b) In order to determine whether the Tender substantially conforms to the technical requirements of the Tender Document, the technical proposal shall broadly cover the following items in relevant Forms:

S. No.	Technical Evaluation Items	Relevant Forms
1.	Site Organization	Form TP-1, Technical Proposal, Section IV Tender Forms
2.	Outline Method Statement	Form TP-2, Technical Proposal, Section IV Tender Form
3.	Works Execution Programme	Form TP-3, Technical Proposal, Section IV Tender Form
4.	Contractor's Representative and Key Personnel as per the List given in Table 1 below	Form PER-1 and Form PER-2, Section IV Tender Form
5.	Key Equipment as per the List given in Table 2 below	Form EQU, Section IV Tender Form

(i) Contractor's Representative and Key Personnel

The Tenderer must demonstrate that it will have a suitably qualified Contractor's Representative and suitably qualified (and in adequate numbers) Key Personnel, as described in the Table below.

Table 1: Contractor's Representative and Key Personnel

S. No.	Designation	Qualification	Minm. Nos. Required	Experience Level
1.	Contractor's Representative / Project Manager	B. Tech in Electrical Engineering	1	Minimum total experience of 10 years out of which, minimum 5 years as In-charge in Electrification projects of Railway/ DFC/ Metro/ RRTS
2.	Senior Engineer (OHE)	B. Tech /Diploma in Electrical Engineering	1	Minimum total experience of 03/05 years out of which minimum 02/03 years (degree/diploma) in Project of 25 kV OHE in Railway/DFC/Metro/RRTS

<i>S. No.</i>	<i>Designation</i>	<i>Qualification</i>	<i>Minm. Nos. Required</i>	<i>Experience Level</i>
3.	Senior Engineer (PSI)	B. Tech /Diploma in Electrical Engineering	1	Minimum total experience of 03/05 years out of which minimum 02/03 years (degree/diploma) in Traction Substations Project of Railway/DFC/Metro/RRTS

The Tenderer shall provide details of the Contractor's Representative and Key Personnel in the relevant Forms PER1 and PER-2 in Section IV, Tender Forms.

(ii) Key Equipment

The Tenderer must demonstrate that it has the key equipment listed in the Table 2 below:

Table 2: Equipment

S. No.	Equipment Type	Minimum Number required
1	Mast Erection Crane	1
2	Ladder Trolley	1
3	Special Trolley for Wiring	1

The Tenderer shall provide details of the Equipment in the relevant Form EQU in Section IV, Tender Forms.

- (c) It is expected that the Tenderer visits the site and is fully aware of all the work requirements under this Tender and then prepares the Technical Part.

All Tenders which are found substantially responsive after Stage 3 evaluation will proceed to the next stage.

4. STAGE 4: Financial Evaluation

The activities in this Stage 4 will be in two (2) parts.

A. Evaluation of Compliance and Responsiveness

- (a) Under this Stage the following items will be checked:
 - (i) Whether the Letter of Tender-Financial Part is compliant (i.e. does not include any alteration to the basic terms and does not constitute an alternative offer).
 - (ii) Whether Financial Part has not been altered and is correctly completed and signed.

B. Detailed Financial Evaluation

- (a) After passing the above requirements, the Tender will then proceed for Financial Part evaluation in accordance with ITT 35.
- (b) In principle, the lowest evaluated Tender resulting from ‘A’ above will move to next stage as per ITT “J. Award of Contract”, described in ITT Clauses 46 to 50.

Checklist-CL

Checklist of submission of Documents/Forms online, duly filled
(Reference to TDS-ITT 11.2 & 11.3, Section II, Part 1)

A. TECHNICAL PART

S. No.	Requirement of Tender Document	Ref. Clause of Tender documents	Tenderer's Name:	
			Whether information submitted (Yes/No/N.A.)	Ref. Pg No. in the Technical Submittal
1.	Letter of Tender-Technical Part	ITT 11.2 (a) and Section IV		
2.	Technical Part signed by authorized representative of Single Entity/Joint Venture	ITT 20.3		
3.	Tender Security- Online Receipt or Scanned copy of Bank Guarantee	ITT 19.1, ITT 19.3 and Appendix E of Section IV		
4.	Form ELI – 1.1: (a) Tenderer Information Form (Single Entity)	ITT 17.1 and Appendix D of Section IV		
5.	Form ELI – 1.1: (b) Tenderer Information Form (JV)	ITT 17.1 and Appendix D of Section IV		
6.	Form ELI – 1.2: Tenderer's JV Member Information Form	ITT 17.1 and Appendix D of Section IV		
7.	Form ELI – 1.3: Joint Venture Agreement	ITT 17.1 and Appendix D of Section IV		
8.	Form ELI-1.4: Power of Attorney (POA) for Submitting Tender	ITT 20.3 and Appendix D of Section IV		
9.	Board Resolution in case of a Public/Private limited company/LLP	TDS ITT 20.3		
10.	Incorporation Certificate and Memorandum and Articles of Association (MOA & AOA) (in case of Private/Public Limited Company)	Note (iii) (d) of Form ELI 1.4		
11.	Incorporation Certificate and Limited Liability Membership Agreement in case of Limited Liability Membership firms.	Note (iii) (e) of Form ELI 1.4		
12.	Proprietorship Affidavit (in case the Tenderer is Proprietorship Tenderer)	Note (iii) (a) of Form ELI 1.4		
13.	Partnership Deed (in case the Tenderer is Partnership Firm)	Note (iii) (b) of Form ELI 1.4		

S. No.	Requirement of Tender Document	Ref. Clause of Tender documents	Tenderer's Name:	
			Whether information submitted (Yes/No/N.A.)	Ref. Pg No. in the Technical Submittal
14.	Form ELI-1.5: Power of Attorney (POA) for Authorized Signatory of Joint venture (JV) Members	ITT 20.4		
15.	Form ELI-1.6: Power of Attorney to Lead Member and Authorised Representative of Joint venture (JV)	ITT 20.4		
16.	In case of foreign tenderer, the Notarised POA/MOU/JV Agreement is notarised in the country of origin and stamped by Indian Embassy/ High Commission or Member Countries of Hague convention submitted these documents with "Apostille" stamp	Note (i) of Form ELI 1.4		
17.	Form CON - 1: Historical Contract Non-Performance, Pending Litigation and Litigation History	ITT 17.2 and Appendix D of Section IV		
18.	Form CON - 2: Environmental, Social, Health, and Safety Performance Declaration	ITT 17.2 and Appendix D of Section IV		
19.	Form FIN – 3.3.1: Financial Situation and Performance	ITT 17.2 and Appendix D of Section IV		
20.	Form FIN – 3.3.2: Average Annual Construction Turnover	ITT 17.2 and Appendix D of Section IV		
21.	Form FIN – 3.3.3: Financial Resources	ITT 17.2 and Appendix D of Section IV		
22.	Form FIN - 3.3.4: Bid Capacity	ITT 17.2 and Appendix D of Section IV		
23.	Form EXP – 3.4.1: General Construction Experience	ITT 17.2 and Appendix D of Section IV		
24.	Form EXP – 3.4.2(a): Specific Construction and Contract Management Experience	ITT 17.2 and Appendix D of Section IV		
25.	<i>Form EXP-3.4.2(b)(i): Specific Construction Experience in Key Activities (i)</i>	<i>ITT 17.2 and Appendix D of Section IV</i>		
26.	<i>Form EXP-3.4.2(b)(ii): Specific Construction Experience in Key Activities (ii)</i>	<i>ITT 17.2 and Appendix D of Section IV</i>		
27.	Form TP-1: Site Organization	ITT 16.1 and Appendix A of Section IV		
28.	Form TP-2: Outline Method Statement	ITT 16.1 and Appendix A of Section IV		

S. No.	Requirement of Tender Document	Ref. Clause of Tender documents	Tenderer's Name:	
			Whether information submitted (Yes/No/N.A.)	Ref. Pg No. in the Technical Submittal
29.	Form TP-3: Work Execution Programme	ITT 16.1 and Appendix A of Section IV		
30.	Form EQU: Equipment	ITT 16.1 and Appendix A of Section IV		
31.	Form PER – 1: Proposed Personnel	ITT 16.1 and Appendix A of Section IV		
32.	Form PER – 2: Resumé of Proposed Personnel	ITT 16.1 and Appendix A of Section IV		
33.	In case of Certificate/documents translated in English from Foreign Language, copy of license of licensed translator issued by the competent authority in their country of origin	ITT 10.1 of Section II		
<p>Note:</p> <p>(i) The check list is indicative and not exhaustive. The Tenderer must go through the complete tender documents and submit the required documents accordingly.</p> <p>(ii) If any of the above form or criteria is not applicable to the Tenderer, then they can simply indicate N.A. against the relevant column</p> <p>(iii) All Tender Forms contained in the Tender Documents must be fully and properly completed and all the forms must be returned signed by Authorized Representative of the Tenderer.</p>				

B. FINANCIAL PART

The Financial Part is provided in the Tender Documents in the form of MS-EXCEL file and PDF file. The Contract Price for the Works shall be quoted in the MS-EXCEL file provided in the e-procurement portal. The Tenderer shall download the MS-EXCEL file and after quoting their Contract Price, upload the same along with other PDF documents of Financial Part mentioned in (a) below as a ZIP file on e-procurement portal. **The quoted Contract Price shall not be offered/quoted elsewhere in the Technical Part submission/ Tender submission.** These prices shall include all costs associated with the contract including GST. The Tenderer shall complete the Financial Part in accordance with the instructions given in the Financial Part.

Following information are required to be submitted by Tenderers in their Financial Part:

(a) In PDF File

1. Letter of Tender – Financial Part
2. Appendix A to Financial Part: Schedule of Adjustment Data
 - Table A: Foreign Currency (FC)
 - Table B: Summary of Payment Currencies
3. Appendix B to Financial Part: Price Schedules
 - Contract Price comprises of the following Schedules:

Schedule	Description	Remarks
A	Lump Sum component of Works	Quoted the total lump sum price for Schedule 'A'
B	OHE works for IR Connectivity and Feeder (Harsana Kalan IR SSP to New Harsana Kalan OHE)	
Sub-Schedule	Description	
B 1	General	Quoted single percentage (%) Excess (+) or Less (-) on the estimated amount for Sub-Schedule 'B1', Sub-Schedule 'B2', Sub-Schedule 'B3', Sub-Schedule 'B4', Sub-Schedule 'B5', Sub-Schedule 'B6', Sub-Schedule 'B7' and Sub-Schedule 'B8' in the prescribed place of Price Schedule in MS-Excel file of Financial Part.
B 2	Concrete	
B 3	Ferrous	
B 4	Non Ferrous	
B 5	Catenary & Contact wire	
B 6	Insulators	
B 7	SCADA at Harsana Kalan IR SSP	
B8	Non-Schedule (NS) Items	

(b) In MS-Excel File

Quoted Price Schedule for the Works against each Schedule.

I hereby confirm that:

- a. I have checked the above list with our submittal. I am also aware that if our tender is not containing the above documents, the Employer has the right to reject our Tender.
- b. All the pages of Tender submission are properly indexed and numbered.

Seal:

Date:

(Signature of Authorized representative of Tenderer)

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Section IV - Tender Forms

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Letter of Tender – Technical Part

INSTRUCTIONS TO TENDERERS: DELETE THIS BOX ONCE YOU HAVE COMPLETED THE DOCUMENT

The Tenderer must prepare this Letter of Tender on stationery with its letterhead clearly showing the Tenderer's complete name and business address.

Note: All italicized text is to help Tenderers in preparing this form.

Date of this Tender submission: [*insert date (as day, month and year) of Tender submission*]

Tender No.: HORC/HRIDC/SYS-1/2023

To:

GM/IE&A,

Haryana Rail Infrastructure Development Corporation Limited (HRIDC),

Plot no.143, 5th floor,

Railtel Tower, Sector-44

Gurugram – 122003

Tel: +91 8860124749

We, the undersigned, hereby submit our Tender, in two parts sealed separately, namely: (a) the Technical Part; and (b) the Financial Part.

In submitting our Tender, we declare that:

- (a) **No Reservations:** We have examined and have no reservations to the Tender Document, including Addenda issued in accordance with ITT 8;
- (b) **Eligibility:** We meet the eligibility requirements and have no conflict of interest in accordance with ITT 4;
- (c) **Tender-Securing Declaration:** We have not been suspended nor declared ineligible by the Employer based on execution of a Tender-Securing or Proposal-Securing Declaration in the Employer's Country in accordance with ITT 4.7;
- (d) **Conformity:** We offer to execute in conformity with the Tender Document and in accordance with the implementation and completion specified in the construction schedule, the following Works: *insert a brief description of the Works*;

_____;

- (e) **Tender Validity Period:** Our Tender shall be valid for the period specified in TDS 18.1 (as amended, if applicable) after the date fixed for the Tender submission deadline specified in TDS 22.1 (as amended, if applicable), and it shall remain binding upon us and may be accepted at any time before the expiration of that period;
- (f) **Performance Security** If our Tender is accepted, we commit to obtain a Performance Security in accordance with the Tender Document;
- (g) **One Tender Per Tenderer:** We are not participating, as a Tenderer, either individually or as a Joint Venture member, in more than one Tender in this tendering process, and meet the requirements of ITT 4.3;
- (h) **Suspension and Debarment:** We, along with any of our subcontractors, suppliers, consultants, manufacturers, or service providers for any part of the contract, are not subject to, and not controlled by any entity or individual that is subject to, a temporary suspension or a debarment or any ineligibility imposed or recognized by the Bank. Further, we are not ineligible under the Employer's Country laws or official regulations or pursuant to a decision of the United Nations Security Council;
- (i) **State-Owned Enterprise or Institution:** *[select the appropriate option and delete the other] [We are not a state-owned enterprise or institution] / [We are a state-owned enterprise or institution but meet the requirements of ITT 4.6];*
- (j) **Binding Contract:** We understand that this Tender, together with your written acceptance thereof included in your Letter of Acceptance, shall constitute a binding contract between us, until a formal contract is prepared and executed;
- (k) **Employer Not Bound to Accept:** We understand that you are not bound to accept the lowest evaluated cost Tender, the Most Advantageous Tender or any other Tender that you may receive;
- (l) **Prohibited Practice:** We hereby certify that we have taken steps to ensure that no person acting for us or on our behalf engages in any type of Prohibited Practice; and
- (m) **Inspection and Audit:** We agree to permit the Bank or its representative to inspect our accounts and records and other documents relating to the tender submission and to have them audited by auditors appointed by the Bank.
- (n) We declare and certify that we have not made any misleading or false representation in the forms, statements and attachments in proof of the qualification requirements.
- (o) We declare that the information and documents submitted along with the tender by us are correct and we are fully responsible for the correctness of the information and documents, submitted by us.
- (p) *[select the appropriate option and delete whichever is not applicable] [We declare and certify that financial data as per the balance sheets for last three financial years including that for the latest concluded financial year are being submitted] OR [We declare and*

certify that balance sheet for the latest concluded financial year has not been finalized till date and that is why we are furnishing financial data for last three financial years ignoring the latest concluded financial year.]

- (q) We undertake to provide the Key Equipment for execution of the work listed in Section III, Evaluation and Qualification Criteria in case the Contract is awarded to us.
- (r) We undertake to provide the Contractor's Representative and Key Personnel for execution of the work listed in Section III, Evaluation and Qualification Criteria in case the Contract is awarded to us.
- (s) I/we have downloaded the Tender Document/addenda/corrigenda/ clarifications along with the set of enclosures hosted on eProcurement portal as mentioned in Tender Document. I/We verified the content of the document from the website and there is no addition, no deletion or no alteration to the content of the Tender Document. In case of any discrepancy noticed at any stage i.e. evaluation of Tenders, execution of work or final payment of the Contract, the master copy of Tender Document available with HRIDC shall be final and binding upon me/us.

Name of the Tenderer: * [*insert complete name of the Tenderer*]

Name of the person duly authorized to sign the Tender on behalf of the Tenderer: **[*insert complete name of person duly authorized to sign the Tender*]

Title of the person signing the Tender: [*insert complete title of the person signing the Tender*]

Signature of the person named above: [*insert signature of person whose name and capacity are shown above*]

Date signed [*insert date of signing*] **day of** [*insert month*], [*insert year*]

*: In the case of the Tender submitted by joint venture specify the name of the Joint Venture as Tenderer

**: Person signing the Tender shall have the power of attorney given by the Tenderer. The power of attorney shall be attached with the Letter of Tender.

Appendix A to Technical Part: Technical Proposal

[Ref. ITT Sub-Clause 16.1, Clause 4 of Section III, Evaluation and Qualification Criteria (EQC)]

- 1. Site Organization**
- 2. Outline Method Statement**
- 3. Work Execution Programme**

Form TP-1
Site Organization

(To be submitted by the Tenderer)

Form TP-2
Outline Method Statement

(To be submitted by the Tenderer)

Form TP-3
Work Execution Programme

(To be submitted by the Tenderer)

Appendix B to Technical Part: Equipment

Form EQU: Equipment

The Tenderer shall provide adequate information to demonstrate clearly that it has the capability to meet the requirements for the key equipment listed in Section III, Evaluation and Qualification Criteria. A separate Form shall be prepared for each item of equipment listed, or for alternative equipment proposed by the Tenderer.

Item of equipment		
Equipment information	Name of manufacturer	Model and power rating
	Capacity	Year of manufacture
Current status	Current location	
	Details of current commitments	
Source	Indicate source of the equipment <input type="checkbox"/> Owned <input type="checkbox"/> Rented <input type="checkbox"/> Leased <input type="checkbox"/> Specially manufactured	

Omit the following information for equipment owned by the Tenderer.

Owner	Name of owner	
	Address of owner	
	Telephone	Contact name and title
	Fax	Email

Agreements	Details of rental / lease / manufacture agreements specific to the project

“We undertake to provide the Key Equipment for execution of the work listed in Section III, Evaluation and Qualification Criteria in case the Contract is awarded to us.”

Tenderer’s Authorized Representative

Signature:

Date:

Company stamp:

Appendix C to Technical Part: Key Personnel

Form PER-1

Contractor's Representative and Key Personnel Schedule

Tenderers should provide the names and details of the suitably qualified Contractor's Representative and Key Personnel to perform the Contract. The data on their experience should be supplied using the Form PER-2 below for each candidate.

Contractor' Representative and Key Personnel

1.	Title of position: Contractor's Representative/ Project Manager	
	Name of candidate:	
	Duration of appointment:	[insert the whole period (start and end dates) for which this position will be engaged]
	Time commitment for this position:	[insert the number of days/week/months/ that has been scheduled for this position]
	Expected time schedule for this position:	[insert the expected time schedule for this position (e.g. attach high level Gantt chart)]
2.	Title of position: [Senior Engineer (OHE)]	
	Name of candidate:	
	Duration of appointment:	[insert the whole period (start and end dates) for which this position will be engaged]
	Time commitment for this position:	[insert the number of days/week/months/ that has been scheduled for this position]
	Expected time schedule for this position:	[insert the expected time schedule for this position (e.g. attach high level Gantt chart)]
3.	Title of position: [Senior Engineer (PSI)]	
	Name of candidate:	
	Duration of appointment:	[insert the whole period (start and end dates) for which this position will be engaged]
	Time commitment for this position:	[insert the number of days/week/months/ that has been scheduled for this position]
	Expected time schedule for this position:	[insert the expected time schedule for this position (e.g. attach high level Gantt chart)]
	Time commitment for this position:	[insert the number of days/week/months/ that has been scheduled for this position]

Expected time schedule for this position:	<i>[insert the expected time schedule for this position (e.g. attach high level Gantt chart)]</i>
--	---

“We undertake to provide the Contractor’s Representative and Key Personnel for execution of the work listed in Section III, Evaluation and Qualification Criteria in case the Contract is awarded to us.”

Tenderer’s Authorized Representative

Signature:

Date:

Company stamp:

**Form PER-2:
Resume and Declaration
Contractor’s Representative and Key Personnel**

Name of Tenderer

Position [#I]: [title of position from Form PER-1]		
Personnel information	Name:	Date of birth:
	Address:	E-mail:
	Professional qualifications:	
	Academic qualifications:	
	Language proficiency: [language and levels of speaking, reading and writing skills]	
Details	Address of employer:	
	Telephone:	Contact (manager / personnel officer):
	Fax:	
	Job title:	Years with present employer:

Summarize professional experience in reverse chronological order. Indicate particular technical and managerial experience relevant to the project.

Project	Role	Duration of involvement	Relevant experience
<i>[main project details]</i>	<i>[role and responsibilities on the project]</i>	<i>[time in role]</i>	<i>[describe the experience relevant to this position]</i>

Declaration

I, the undersigned *[insert either “Contractor’s Representative” or “Key Personnel” as applicable]*, certify that to the best of my knowledge and belief, the information contained in this Form PER-2 correctly describes myself, my qualifications and my experience.

I confirm that I am available as certified in the following table and throughout the expected time schedule for this position as provided in the Tender:

Commitment	Details
Commitment to duration of contract:	<i>[insert period (start and end dates) for which this Contractor's Representative or Key Personnel is available to work on this contract]</i>
Time commitment:	<i>[insert period (start and end dates) for which this Contractor's Representative or Key Personnel is available to work on this contract]</i>

I understand that any misrepresentation or omission in this Form may:

- (a) be taken into consideration during Tender evaluation;
- (b) result in my disqualification from participating in the Tender;
- (c) result in my dismissal from the contract.

Name of Contractor's Representative or Key Personnel: *[insert name]*

Signature: _____

Date: (day month year): _____

Countersignature of authorized representative of the Tenderer:

Signature: _____

Date: (day month year): _____

Appendix D to Technical Part: Tenderer's Qualification

To establish its qualifications to perform the contract in accordance with Section III, Evaluation and Qualification Criteria the Tenderer shall provide the information requested in the corresponding Information Sheets included hereunder.

Form ELI-1.1 (a)

Tenderer Information Form (Single Entity)

[Ref. ITT Sub-Clause 17.1]

Date: _____
Tender No. and title: _____
Page _____ of _____ pages

Tenderer's name
Tenderer's actual or intended country of registration: <i>[indicate country of Constitution]</i>
Tenderer's actual or intended year of incorporation:
Tenderer's legal address [in country of registration]:
Tenderer's authorized representative information Name: _____ Address: _____ Mobile number: _____ Telephone/Fax numbers: _____ E-mail address: _____
1. Attached are copies of original documents of <input type="checkbox"/> Articles of Incorporation (or equivalent documents of constitution or association), and/or documents of registration of the legal entity named above, in accordance with ITT 4.4 <input type="checkbox"/> In case of state-owned enterprise or institution, in accordance with ITT 4.6, documents establishing: • Operation on a commercial basis; • Financial and managerial autonomy; • Day-to-day management not controlled by the government; and Not under the supervision of the Employer or its procuring agency.

Tenderer's Authorized Representative

Signature:
Date:
Company stamp:

Form ELI-1.1 (b)
Tenderer Information Form (JV)
 [Ref. ITT Sub-Clause 17.1]

Date: _____
 Tender No. and title: _____
 Page _____ of _____ pages

Tenderer's JV name
Name of each member: of JV
Tenderer's actual or intended country of registration: <i>[indicate country of Constitution]</i>
Tenderer's actual or intended year of incorporation:
Tenderer's legal address [in country of registration]:
*Tenderer's authorized representative information Name: _____ Address: _____ Mobile number: _____ Telephone/Fax numbers: _____ E-mail address: _____
Attached are copies of original documents of <input type="checkbox"/> In case of intended JV, letter of intent to form JV or JV agreement, in accordance with ITT 4.1

Tenderer's Authorized Representative

Signature:
 Date:
 Company stamp:

Note:

2. *Tenderer's Authorized Representative shall be from Lead Member of JV.

Form ELI-1.2

Tenderer’s JV Member Information Form

[Ref. ITT Sub-Clause 17.1]

(To be completed for each member of Tenderer’s JV)

Date: _____

TENDER No. and title: _____

Page _____ of _____ pages

Tenderer’s JV name:
JV member’s name:
JV member’s country of registration:
JV member’s year of constitution:
JV member’s legal address in country of constitution:
JV member’s authorized representative information Name: _____ Address: _____ Mobile: _____ Telephone/Fax numbers: _____ E-mail address: _____
1. Attached are copies of original documents of <input type="checkbox"/> Articles of Incorporation (or equivalent documents of constitution or association), and/or registration documents of the legal entity named above, in accordance with ITT 4.4. <input type="checkbox"/> In case of a state-owned enterprise or institution, documents establishing operation on a commercial basis; financial and managerial autonomy; day-to-day management not controlled by the government; and not under the supervision of the Employer or its procuring agency, in accordance with ITT 4.6. 2. Included are the organizational chart, a list of Board of Directors in the Attachment 1 given below, and the beneficial ownership [If required under TDS ITT 48.1, the successful Tenderer shall provide additional information on beneficial ownership for each JV member using the Beneficial Ownership Disclosure Form.]

Tenderer’s Authorized Representative

Signature:

Date:

Company stamp:

Attachment 1 to Form ELI-1.2

1. Organizational chart,

(To be submitted by each JV member of the Tenderer)

2. List of Board of Directors,

(To be submitted by each JV member of the Tenderer)

Form ELI-1.3

Joint Venture Agreement

[Ref. ITT Sub-Clause 4.1 and ITT Sub-Clause 11.5]

The Members of the Joint Venture shall provide Joint Venture Agreement for Joint Venture Participation in the name of M/s.....of which includes at least the followings: -

(i) M/s having its registered office at (hereinafter referred to as) acting as the Lead Member of the first part;

And

(ii) M/shaving its registered office at (hereinafter referred to as `.....`) in the capacity of a Joint Member of the other part;

And

(iii) M/shaving its registered office at (hereinafter referred to as `.....`) in the capacity of a Joint Member of the other part.

The expressions of (i) ,..... (ii) (iii) (names of JV Members) shall wherever the context admits, mean and include their respective legal representatives, successors-in-interest and assigns and shall collectively be referred to as “ the Parties” and individually as “ the Party”

WHEREAS:

Haryana Rail Infrastructure Development Corporation Ltd. on behalf of Haryana Orbital Rail Corporation Ltd. [hereinafter referred to as “Employer”] has invited tenders for “[Insert name of work].....”

NOW, THEREFORE, THE PARTIES AGREE AS FOLLOWS:

1. The following documents shall be deemed to form and be read and construed as an integral part of this JV agreement.
 - i) Specific Procurement Notice, ii) Tender document, iii) Any Addendum/ Corrigendum issued by Haryana Rail Infrastructure Development Corporation Ltd.
 - iv) The Tender submitted on our behalf jointly by the Lead Member/ authorised representative.
2. The `Parties` have studied the documents and have agreed to participate in submitting a tender jointly in the name of-----.
3. M/sshall be the lead Member of the JV/for all intents and purpose and shall represent the Joint Venture in its dealing with the Employer. For the purpose of submission of tenders, the parties agree to nominate as the Lead Member duly authorized to sign and submit all documents and subsequent clarifications, if any, to the Employer. However, M/s shall not submit any such tenders,

clarifications or commitments before securing the written clearance of the other Member which shall be expeditiously given by M/s..... and M/s..... to M/s.....

4. The ‘Parties’ have resolved that the distribution of share and responsibilities between the JV Members is as under:-
- a) Lead Member Name.....and share% ;
 - b) Joint Venture Member Name.....and share% ;
 - c) Joint Venture Member Name.....and share% ;

5. JOINT AND SEVERAL RESPONSIBILITIES

The Parties undertake that they shall be jointly and severally liable to the Employer in the discharge of all the obligations and liabilities as per the contract with the Employer and for the performance of contract awarded to their JV

6. ASSIGNMENT AND THIRD PARTIES

The parties shall co-operate throughout the entire period of this Joint Venture Agreement on the basis of exclusivity and neither of the Parties shall make arrangement or enter into agreement either directly or indirectly with any other party or group of parties on matters relating to the Project except with prior written consent of the other party and the Employer.

7. EXECUTIVE AUTHORITY

The said Joint Venture through its authorized representative shall receive instructions from the Employer. The management structure for the project shall be prepared by mutual consultations to enable completion of project to quality requirements within permitted cost and time.

8. PROPOSAL SUBMISSION

Each Party shall bear its own cost and expenses for preparation and submission of the tender and all costs until conclusion of a contract with the Employer for the Project. Common expenses shall be shared by all the parties in the ratio of their actual participation.

9. INDEMNITY

Each party hereby agrees to indemnify the other party against its respective parts in case of breach/default of the respective party of the contract works of any liabilities sustained by the Joint Venture.

10. For the execution of the respective portions of works, the parties shall make their own arrangements to bring the required finance, plants and equipment, materials, manpower and other resources.

11. DOCUMENTS & CONFIDENTIALITY

Each Party shall maintain in confidence and not use for any purpose related to the Project all commercial and technical information received or generated in the course of preparation and submission of the tender.

12. ARBITRATION

Any dispute, controversy or claim arising out of or relating to this Joint Venture agreement shall be settled in the first instance amicably between the parties. If an amicable settlement cannot be reached as above, it will be settled by JV in accordance with arbitral agreement mutually agreed by the parties. The venue of the arbitration shall be _____.

13. VALIDITY

This Joint Venture agreement shall remain in force till the occurrence of the earliest of any of the following, unless by mutual consent, the Parties agree in writing to extend the validity for a further period.

- a. The Tender submitted by the Joint Venture is declared unsuccessful, or
- b. Cancellation/ shelving of the Project by the Employer for any reasons prior to award of work
- c. Execution of detailed JV agreement by the parties, setting out detailed terms after award of work by the Employer.

14. This Joint Venture agreement is drawn in number of copies with equal legal strength and status. One copy is held by M/s and the other by M/s. and M/s. and a copy submitted with the tender.

15. This Joint Venture agreement shall be construed under the laws of India.

16. NOTICES BETWEEN JV MEMBERS

Notices shall be given in writing by fax confirmed by registered mail or commercial courier to the following fax numbers and addresses:

Lead Member.	Other Member	Other Member
.....
.....
(Name & Address)	(Name & Address)	(Name & Address)

IN WITNESS WHEREOF THE PARTIES, have executed this MOU the day, month and year first before written

M/s.....	M/s.....	M/s.....
.....
(Seal)	(Seal)	(Seal)

Witness

1.....(Name & Address)

2..... (Name & Address)

Form ELI-1.4

[Ref. ITT Sub-Clause 20.3]

Power of Attorney (POA) for Submitting Tender (For Single Entity/Sole Tenderer only)

(To be executed on non-judicial stamp paper of the appropriate value in accordance with relevant stamp Act. The stamp paper to be in the name of the company who is issuing the Power of Attorney)

Know all men by these presents, we..... (name and address of the registered office) do hereby constitute, appoint and authorise Mr/Ms..... (name and residential address) who is presently employed with us and holding the position ofas our attorney, to do in our name and on our behalf, all such acts, deeds and things necessary in connection with or incidental to our tender for the work of **Contract Package SYS-1: Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km (-) 2.099 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 315 TKM).** , including signing and submission of all documents and providing information/ responses to Haryana Rail Infrastructure Development Corporation Ltd (HRIDC), representing us in all matters before HRIDC, and generally dealing with HRIDC in all matters in connection with our tender for the said project.

We hereby agree to ratify all acts, deeds and things lawfully done by our said attorney pursuant to this Power of Attorney and that all acts, deeds and things done by our aforesaid attorney shall and shall always be deemed to have been done by us.

..... (Signature)
(Name, Title and address) of the **Person Accepting the POA.**

..... (Signature)
(Name, Title and address) of the **Person issuing the POA**

Notes:

- i. The tenderer should submit the notarised Power of Attorney. In case of Foreign Members, Power of Attorney(s) and Board Resolution confirming authority on the persons issuing the Power of Attorney for such actions shall be submitted duly notarized by the notary public of country of origin and should be either stamped by Indian Embassy/High Commission or Member Countries of Hague convention may submit these document with “Apostille” stamp.

Also, in case the documents are in foreign language the translation of the same shall be authenticated by Embassy/High Commission.

- ii. The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executant(s) and when it is so required the same should be under common seal affixed in accordance with the required procedure.
- iii. The tenderer should submit following additional document in support of the POA as case to case basis:
 - a) Proprietorship Affidavit in case of Proprietary Tenderer.
 - b) Partnership Deed in case of Partnership Firms.
 - c) Board Resolution in case of a Public/Private limited company/LLP.
 - d) Incorporation Certificate and Memorandum & Article of Association in case of a Public/Private limited company.
 - e) Incorporation Certificate and Limited Liability Membership Agreement in case of Limited Liability Membership firms.

Form ELI-1.5

Power of Attorney (POA) for Authorized Signatory of Joint Venture (JV) Members
[Ref. ITT Sub-Clause 20.4]
(To be submitted by Tenderer’ each JV member)

POWER OF ATTORNEY*

(To be executed on non-judicial stamp paper of the appropriate value in accordance with relevant stamp Act. The stamp paper to be in the name of the company who is issuing the Power of Attorney)

Know all men by these presents, we..... do hereby constitute, appoint and authorise Mr/Ms. who is presently employed with us and holding the position ofas our attorney, to do in our name and on our behalf, all such acts, deeds and things necessary in connection with or incidental to our tender for the work of **Contract Package SYS-1: Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km (-) 2.099 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 315 TKM).** , including signing and submission of all documents, withdrawal, substitution and modification of tender and providing information/ responses to Haryana Rail Infrastructure Development Corporation Ltd, representing us in all matters, dealing with Haryana Rail Infrastructure Development Corporation Ltd. in all matters in connection with our tender for the said project.

We hereby agree to ratify all acts, deeds and things lawfully done by our said attorney pursuant to this Power of Attorney and that all acts, deeds and things done by our aforesaid attorney shall and shall always be deemed to have been done by us.

Dated this the day of 20..

(Signature of authorised Signatory in token of **Acceptance of POA**

.....

(Signature and Name in Block letters of Signatory)

Seal of Company

Witness

Witness 1:

Name:

Address:

Occupation:

Witness 2:

Name:

Address:

Occupation:

**Notes:*

- i) To be executed by all the Members individually, in case of a Joint Venture.
- ii) The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executant(s) and when it is so required the same should be under common seal affixed in accordance with the required procedure.

Form ELI-1.6

Power of Attorney to Lead Member and Authorized Representative of Joint Venture (JV)

[Ref. ITT Sub-Clause 20.4]

(To be executed on non-judicial stamp paper of the appropriate value in accordance with relevant stamp Act. The stamp paper to be in the name of the company who is issuing the Power of Attorney)

POWER OF ATTORNEY¹

Whereas Haryana Rail Infrastructure Development Corporation Ltd. has invited Tenders for the work of

on behalf of Haryana Orbital Rail Corridor Limited [hereinafter referred to as “Employer”]

Whereas, the Members of the Joint Venture comprising

1. M/s.,

2. M/s.,

and

3. M/s.,

are interested in submission of tender for the work of “**Contract Package SYS-1: Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km (-) 2.099 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 315 TKM).** in accordance with the terms and conditions contained in the tender documents.

Whereas, it is necessary for the Members of the Joint Venture to designate one of them as the Lead Member as the authorized representative, with all necessary power and authority to do, for and on behalf of the Joint Venture, all acts, deeds and things as may be necessary in connection with the Joint Venture’s tender for the project.

NOW THIS POWER OF ATTORNEY WITNESSETH THAT:

We, M/s. (Lead Member), M/s_____ and M/s_____ hereby designate M/s., being one of the Members of the Joint Venture, as the Lead Member of the Joint Venture and designate Mr/Ms. _____ being authorized representative of the Joint Venture, to do on behalf of the Joint Venture, all or any of the acts, deeds or things necessary or incidental to the Joint Venture’s tender for the contract, including submission of tender, withdrawal, substitution and modification of tender, participating in conferences, responding to queries, submission of information/ documents and generally to represent the Joint Venture in all its dealings with the Employer or any other Government Agency or any person, in connection with the contract for the said work until culmination of the process of tendering till the contract agreement is entered into with the Haryana Orbital Rail Corporation Limited and thereafter till the expiry of the contract agreement.

We hereby agree to ratify all acts, deeds and things lawfully done by Lead Member, our said attorney, pursuant to this power of attorney and that all acts deeds and things done by our aforesaid attorney shall and shall always be deemed to have been done by us/ Joint Venture.

Dated this the Day of 20.....

(Signature)	(Signature)	(Signature)
.....

(Name in Block letters of all Executants with Seal of Company)

..... (Signature)

(Name, Title and address) of the **Person Accepting the POA**

Witness 1:	Witness 2:
Name:	Name:
Address:	Address:
Occupation:	Occupation:

Notes:

1. To be executed by all the Authorized POA holders of each Members of the JV.
2. The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executant(s) and when it is so required the same should be under common seal affixed in accordance with the required procedure.
3. Authorized Representative of Tenderer’s JV shall be from Lead Member of JV.

Form CON-1**Historical Contract Non-Performance, Pending Litigation and Litigation History**

[Ref. ITT Sub-Clause 17.2 and Section III, Evaluation and Qualification Criteria, Sub-Clause 3.2.1 and Sub-Clause 3.2.3]

[The following table shall be filled in for the Tenderer or in case of JV, each member of a Joint Venture]

Tender No.: HORC/HRIDC/SYS-1 /2023

Tenderer's Name: _____

JV Member's Name _____

Page _____ of _____ pages

1. Non-Performed Contracts in accordance with Section III, Evaluation and Qualification Criteria				
Description				YES/NO
(i) Whether Contract(s) Non-Performance occurred as a result of Contractor's default since 1st April 2018 specified in Section III, Evaluation and Qualification Criteria, requirement 3.2.1				
(ii) If answer to (i) above is YES, then following details to be submitted:				
S. No.	Year	Non-performed portion of contract	Contract Identification	Total Contract Amount (current value, currency, exchange rate and INR equivalent)
	[insert year]	[insert amount and percentage]	Contract Identification: [indicate complete contract name/ number, and any other identification] Name of Employer: [insert full name] Address of Employer: [insert street/city/country] Reason(s) for nonperformance: [indicate main reason(s)]	[insert amount]

2. Pending Litigation resulting from contracts completed or in ongoing contracts over the last five years, in accordance with Section III, Evaluation and Qualification Criteria	
Description	YES/NO
(i) Whether any litigation is still pending against the Contractor in accordance with Section III, Evaluation and Qualification Criteria, Sub-Clause 3.2.3.	

(ii) If answer to (i) above is YES, then following details to be submitted:				
S. No.	Year of dispute	Amount in dispute against Tenderer (currency)	Contract Identification	Total Contract Amount (currency), INR Equivalent (exchange rate)
			Contract Identification: _____ Name of Employer: _____ Address of Employer: _____ Matter in dispute: _____ Party who initiated the dispute: _____ Status of dispute: _____	
			Contract Identification: _____ Name of Employer: _____ Address of Employer: _____ Matter in dispute: _____ Party who initiated the dispute: _____ Status of dispute: _____	
Total Amount in dispute against Tenderer under pending litigation (INR Equivalent), (A)				

3. Pending Arbitration resulting from contracts completed or in ongoing contracts over the last five years, in accordance with Section III, Evaluation and Qualification Criteria				
Description				YES/NO
(i)	Whether any arbitration is still pending against the Contractor in accordance with Section III, Evaluation and Qualification Criteria, Sub-Clause 3.2.3.			
(ii) If answer to (i) above is YES, then following details to be submitted:				
S. No.	Year of dispute	Amount in dispute against Tenderer (currency)	Contract Identification	Total Contract Amount (currency), INR Equivalent (exchange rate)

			Contract Identification: _____ Name of Employer: _____ Address of Employer: _____ Matter in dispute: _____ Party who initiated the dispute: _____ Status of dispute: _____	
			Contract Identification: _____ Name of Employer: _____ Address of Employer: _____ Matter in dispute: _____ Party who initiated the dispute: _____ Status of dispute: _____	
Total Amount in dispute against Tenderer in Arbitration (INR Equivalent), (B)				
Total Amount in dispute against Tenderer under pending litigation and Arbitration (INR Equivalent), C= (A) + (B)				

4. Litigation History in accordance with Section III, Evaluation and Qualification Criteria				
Description				YES/NO
(i) Whether any Litigation History in accordance with Section III, Evaluation and Qualification Criteria, Sub-Clause 3.2.4.				
(ii) If answer to (i) above is YES, Litigation History in accordance with Section III, Evaluation and Qualification Criteria, Sub-Clause 3.2.4 is indicated below.				
S. No.	Year of award	Outcome as percentage of Net Worth	Contract Identification	Total Contract Amount (currency), INR Equivalent (exchange rate)
	<i>[insert year]</i>	<i>[insert percentage]</i>	Contract Identification: <i>[indicate complete contract name, number, and any other identification]</i> Name of Employer: <i>[insert full name]</i> Address of Employer: <i>[insert street/city/country]</i> Matter in dispute: <i>[indicate main issues in dispute]</i> Party who initiated the dispute: <i>[indicate "Employer" or "Contractor"]</i> Reason(s) for Litigation and award decision <i>[indicate main reason(s)]</i>	<i>[insert amount]</i>

Tenderer’s Authorized Representative

Signature:
Date:
Company stamp:

Chartered Accountant/Company Auditor/Statutory Auditor

Certified that the information furnished above is correct as per the audited balance sheets of the entity.

Signature:
Name:
Position:
Date:

Note: The Tenderer shall provide accurate information in Form CON-1 about any pending litigation and pending arbitration resulting from contracts completed or in ongoing contracts over the last five years since 1st April 2018 till 28 days prior to deadline of Tender submission..

Form CON-2

Environmental, Social, Health, and Safety Performance Declaration

[Ref. ITT Sub-Clause 17.2 and Section III, Evaluation and Qualification Criteria, Sub-Clause 3.2.5]

[The following table shall be filled in for the Tenderer or in case of JV, each member of a Joint Venture]

Tender No.: HORC/HRIDC/SYS-1 /2023

Tenderer's Name: _____

JV Member's Name _____

Page _____ of _____ pages

Environmental, Social, Health, and Safety Performance Declaration in accordance with Sub-Clause 3.2.5, Section III, Qualification Criteria and Requirements				
Description				YES/NO
(i) Declaration of suspension or termination of contract:				
Whether contract(s) has/have been suspended or terminated and/or Performance Security called by an employer(s) for reasons related to Environmental, Social, Health, or Safety (ESHS) performance since the date specified in Section III, Qualification Criteria, and Requirements, Sub-Clause 3.2.5.				
(ii) If answer to (i) above is YES, then following details to be submitted:				
a. Details of Contract(s) suspended/terminated by an employer(s) for reasons related to ESHS performance				
S. No.	Year	Suspended or terminated portion of contract	Contract Identification	Total Contract Amount (current value, currency, exchange rate and INR equivalent)
	<i>[insert year]</i>	<i>[insert amount and percentage]</i>	Contract Identification: <i>[indicate complete contract name/ number, and any other identification]</i> Name of Employer: <i>[insert full name]</i> Address of Employer: <i>[insert street/city/country]</i> Reason(s) for suspension or termination: <i>[indicate main reason(s)]</i>	<i>[insert amount]</i>
	<i>[insert year]</i>	<i>[insert amount and percentage]</i>	Contract Identification: <i>[indicate complete contract name/ number, and any other identification]</i>	<i>[insert amount]</i>

			Name of Employer: <i>[insert full name]</i> Address of Employer: <i>[insert street/city/country]</i> Reason(s) for suspension or termination: <i>[indicate main reason(s)]</i>	
	<i>[list all applicable contracts]</i>	...
b. Details of Contract(s) in which Performance Security called by an employer(s) for reasons related to ESHS performance				
S. No.	Year	Contract Identification		Total Contract Amount (current value, currency, exchange rate and INR equivalent)
	<i>[insert year]</i>	Contract Identification: <i>[indicate complete contract name/ number, and any other identification]</i> Name of Employer: <i>[insert full name]</i> Address of Employer: <i>[insert street/city/country]</i> Reason(s) for calling of performance security: <i>[indicate main reason(s)]</i>		<i>[insert amount]</i>

Tenderer's Authorized Representative

Signature:

Date:

Company stamp:

Form FIN-3.3.1:**Financial Situation and Performance**

[Ref. ITT Sub-Clause 17.2 and Section III, Evaluation and Qualification Criteria, Sub-Clause 3.3.1 (ii)]

[The following table shall be filled in for the Tenderer or in case of JV, each member of a Joint Venture]

Tender No.: HORC/HRIDC/SYS-1/2023

Tenderer's Name: _____

JV Member's Name _____

Page _____ of _____ pages

Financial data

(All amounts in Millions)

Type of Financial information in (currency)	Historic information for last three Financial Years, (amount in currency, currency, exchange rate*, INR equivalent)		
	Year 1: 2019-20	Year 2:2020-21	Year 3:2021-22
	Statement of Financial Position (Information from Balance Sheet)		
Total Assets (TA)			
Total Liabilities (TL)			
Total Equity/Net Worth (NW) = TA-TL			
Current Assets (CA)			
Current Liabilities (CL)			
Working Capital (WC)			
Total Revenue (TR)			
Profits Before Taxes (PBT)			

*Refer to Notes: Exchange Rate for Qualification Criteria, Section III, EQC.

Notes:

- (i) *In case, the Financial Year is the same as the Calendar Year, the financial data for the year 2019, 2020 and 2021 shall be furnished.*

- (ii) *The Tenderer is not required to submit any document as documentary evidence along with the Tender Documents. All information furnished in this Form shall be certified by a Chartered Accountant/Company Auditor/Statutory Auditor.*
- (iii) *The Form duly certified by a Chartered Accountant/Company Auditor/Statutory Auditor shall also be signed by Tenderer’s Authorized representative.*
- (iv) *The above documents shall reflect the financial situation of the legal entity or entities comprising the Tenderer and not the Tenderer’s parent companies, subsidiaries, or affiliates.*
- (v) *In the event that the audited accounts for the latest concluded Financial Year are not available, the Tenderer shall furnish information pertaining to the last three financial years after ignoring the latest concluded financial year. In case, the Tenderer submits audited financial information for the last four or more years, only the figures for the latest three years shall be considered for evaluation.*
- (vi) *In case audited balance sheet of the last financial year is not available with the tenderer, he will declare the same vide item (p) prescribed in the Letter of Tender-Technical Part.*
- (vii) ***If the value of Net Worth is not submitted for any of the last three years, the Tender shall be considered nonresponsive and shall be summarily rejected.***

Tenderer’s Authorized Representative

Signature:

Date:

Company stamp:

Chartered Accountant/Company Auditor/Statutory Auditor

Certified that the information furnished above is correct as per the audited balance sheets of the entity.

Signature:

Name:

Position:

Date:

Company:

Company stamp:

Membership No:

Address:

Contact No:

Email ID:

Form FIN-3.3.2:**Average Annual Construction-Turnover**

[Ref. ITT Sub-Clause 17.2, Section III, Evaluation and Qualification Criteria, Sub-Clause 3.3.2 and Sub-Clause 3.3.3]

[The following table shall be filled in for the Tenderer or in case of JV, each member of a Joint Venture]

Tender No.: HORC/HRIDC/SYS-1 /2023

Tenderer's Name: _____

JV Member's Name _____

Page _____ of _____ pages

(All amounts in Millions)

Annual Turnover Data for the Last Three (03) Financial Years (Construction Only)			
Year	Amount Currency	*Exchange Rate	INR Equivalent
2019-20	<i>[insert amount and indicate currency]</i>		
2020-21			
2021-22			
Average Annual Construction Turnover			

* See Section III, Evaluation and Qualification Criteria, Sub-Clause 3.3.2.

Notes:

- (i) *In case, the Financial Year is the same as the Calendar Year, the turnover for the year 2019, 2020 and 2021 shall be furnished.*
- (ii) *The Average Annual Construction Turnover shall be calculated by adding the turnover amount of last three financial years divided by three.*
- (iii) *The Tenderer is not required to submit any document as documentary evidence along with the Tender Documents. All information furnished in this Form shall be certified by a Chartered Accountant/Company Auditor/Statutory Auditor.*
- (iv) *The Form duly certified by a Chartered Accountant/Company Auditor/Statutory Auditor shall also be signed by Tenderer's Authorized representative.*
- (v) *The above documents shall reflect the financial situation of the legal entity or entities comprising the Tenderer and not the Tenderer's parent companies, subsidiaries, or affiliates.*

- (vi) *In the event that the audited accounts for the latest concluded Financial Year are not available, the Tenderer shall furnish information pertaining to the last three financial years after ignoring the latest concluded financial year. In case, the Tenderer submits audited financial information for the last four or more years, only the figures for the latest three years shall be considered for evaluation.*
- (vii) *In case audited balance sheet of the last financial year is not available with the tenderer, he will declare the same vide item (p) prescribed in the Letter of Tender-Technical Part..*
- (viii) *If the value of Annual construction Turnover is not submitted for any of the last three years prescribed in Financial Data, the Tender shall be evaluated by considering “NIL” Turnover for that year(s).*

Tenderer’s Authorized Representative

Signature:

Date:

Company stamp:

Chartered Accountant/Company Auditor/Statutory Auditor

Certified that the information furnished above is correct as per the audited balance sheets of the entity.

Signature:

Name:

Position:

Date:

Company:

Company stamp:

Membership No:

Address:

Contact No:

Email ID:

Form FIN-3.3.3:**Sources of Finance for the Subject Contract (i.e. SYS-1)**

[Ref. ITT Sub-Clause 17.2 and Section III, Evaluation and Qualification Criteria, Sub-Clause 3.3.1 (i)]

[The following table shall be filled in for the Tenderer or in case of JV, each member of a Joint Venture]

Tender No.: HARC/HRIDC/SYS-1 /2023

Tenderer's Name: _____

JV Member's Name _____

Page _____ of _____ pages

Tenderer should specify proposed sources of financing, such as liquid assets, unencumbered real assets, lines of credit, and other financial means, net of current contract commitments, available to meet the total construction cash flow demands of the subject contract **i.e. Package SYS-1**.

(All amounts in Millions)

Financial Resources for Package SYS-1		
No.	Source of financing	Amount (INR equivalent)
1		
2		
3		
	Total Sources of Finance for Package SYS-1	

- (i) *The Tenderer is not required to submit any document as documentary evidence along with the Tender Documents. All information furnished in this Form shall be certified by a Chartered Accountant/Company Auditor/Statutory Auditor.*
- (ii) *The Form duly certified by a Chartered Accountant/Company Auditor/Statutory Auditor shall also be signed by Tenderer's Authorized representative.*
- (iii) *The above documents shall reflect the financial situation of the legal entity or entities comprising the Tenderer and not the Tenderer's parent companies, subsidiaries, or affiliates.*

Tenderer's Authorized Representative

Signature:

Date:

Company stamp:

Chartered Accountant/Company Auditor/Statutory Auditor

Certified that the information furnished above is correct.

Signature:

Name:

Position:

Date:

Company:

Company stamp:

Membership No:

Address:

Contact No:

Email ID:

Form FIN-3.3.4:**Bid Capacity**

[Ref. ITT Sub-Clause 17.2, Section III, Evaluation and Qualification Criteria, Sub-Clause 3.3.3)]

[The following table shall be filled in for the Tenderer or in case of JV, each member of a Joint Venture]

Tender No.: HORC/HRIDC/SYS-1 /2023

Tenderer's Name: _____

JV Member's Name _____

Page _____ of _____ pages

1.0 Bid Capacity:

The available bid capacity shall be calculated as under:

Available Bid Capacity = $[A \times N \times 2] - 0.33 \times N \times B$

Where,

A = Maximum value of construction works executed and payment received in any one of the previous three financial years, taking into account the completed as well as works in progress.

N = Number of years prescribed for completion of work for which Tender has been invited (**i.e 4.0 years**).

B = Existing commitments and balance amount of ongoing works with tenderer and also the works which are awarded to tenderer but yet not started upto the date of inviting the Tender.

Note:**(a) The Tenderer(s) shall furnish the details of :**

- (i) Maximum value of construction works executed and payment received in any one of the previous three financial years for calculating 'A', and
- (ii) Existing commitments and balance amount of ongoing works with tenderer and also the works which are awarded to tenderer but yet not started upto the date of inviting the Tender for calculating 'B'. The details shall be submitted in the prescribed proforma given under **2.0 below**. In case of no works in hand, a 'NIL' statement should be furnished.

The submitted details for (i) and (ii) above should be duly verified by Chartered Accountant.

(b) In case if a tenderer is JV, the Tenderer(s) must furnish the details of:

- (i) Maximum value of construction-works executed and payment received in any one of the previous three financial years by each member of JV for calculating 'A', and

- (ii) Existing commitments and balance amount of ongoing works with each member of JV either in individual capacity or as a member of other JV and also the works which are awarded to each member of JV either in individual capacity or as a member of other JV but yet not started upto the date of inviting the Tender for calculating ‘B’. The details shall be submitted by each member of JV in the prescribed proforma given under **2.0 below**. In case of no works in hand, a ‘NIL’ statement should be furnished.

The submitted details for (i) and (ii) above should be duly verified by Chartered Accountant.

- (c) Value of a completed work/work in progress/work awarded but yet not started for a Member in an earlier JV shall be reckoned only to the extent of the concerned member’s share in that JV for the purpose of satisfying his/her compliance to the above mentioned Bid Capacity in the Tender under consideration.
- (d) For assessing the combined Bid capacity of JV, the arithmetic sum of individual “Bid Capacity” of all the members shall be taken.
- (e) In case, the Tenderer/s failed to submit the above statement along with offer, their/his offer shall be considered as incomplete and will be rejected summarily.
- (f) **The Available Bid Capacity of Tenderer shall be assessed based on the details submitted by the Tenderer.** In case, the available bid capacity is less than that prescribed in Sub-Clause 3.3.1 (ii), Section III, EQC , then the offer shall not be considered even if the Tenderer has been found eligible in other eligibility criteria/tender requirement.

2.0 Tenderer should provide information on their current commitments on all contract that have been awarded, or for which a letter of intent or acceptance has been received, or for contracts approaching completion, but for which an unqualified, full completion certificate is yet to be issued.

Current Contract Commitments /Works in Progress

(All amounts in INR)

S. No.	Name and Brief particulars of contract (Clearly indicate the part of the work assigned to the applicant)	Contract No. & Date	Name of client with telephone number	Contract Value in INR Equivalent (Give only the value of work assigned to the applicant)	Stipulated Period of completion	Value of balance work yet to be done in INR equivalent upto the date of inviting the Tender
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Total value of balance work yet to be done in INR equivalent upto the date of inviting the Tender						B=

Notes:

- (i) Where a work is undertaken by a JV, only that portion of the contract which is undertaken by the concerned applicant/member should be indicated and the remaining done by the other members of the JV be excluded.
- (ii) The Tenderer is not required to submit any document as documentary evidence along with the Tender Documents. **All information furnished in this Form shall be certified by a Chartered Accountant/Company Auditor/Statutory Auditor.**
- (iii) The above documents shall reflect the financial situation of the legal entity or entities comprising the Tenderer and not the Tenderer's parent companies, subsidiaries, or affiliates.

"Certified that current commitments on all the contracts that have been awarded or for which a letter of intent or acceptance has been received or for the works in progress or the works approaching completion, value of outstanding work has been indicated in the above table correctly. It is further certified that if later on the Employer discovers that information provided in the table is incorrect then the Employer will treat our Tender invalid and it will be liable for rejection"

3.0 Calculation of Available Bid Capacity

Description	Value
A = Maximum value of construction works executed and payment received in any one of the previous three financial years, taking into account the completed as well as works in progress as per FORM FIN 3.3.2 (in INR Equivalent)	
N = Number of years prescribed for completion of work for which Tender has been invited (in years)	4
B = Existing commitments and balance amount of ongoing works with tenderer and also the works which are awarded to tenderer but yet not started upto the date of inviting the Tender (in INR Equivalent)	
Bid Capacity (in INR Equivalent) = [A x N x 2] – 0.33xNx B	

Tenderer's Authorized Representative

Signature:

Date:

Company stamp:

Chartered Accountant/Company Auditor/Statutory Auditor

Certified that the information furnished above is correct.

Signature:

Name:

Position:

Date:

Company:

Company stamp:

Membership No:

Address:

Contact No:

Email ID:

Form EXP-3.4.1**General Construction Experience**

[Ref. ITT Sub-Clause 17.2 and Section III, Evaluation and Qualification Criteria, Sub-Clause 3.4.1]

[The following table shall be filled in for the Tenderer or in case of JV, each member of a Joint Venture]

Tender No.: HORC/HRIDC/SYS-1 /2023

Tenderer's Name: _____

JV Member's Name _____

Page _____ of _____ pages

Details of Works executed under infrastructure contracts involving electrical works in the role of Prime Contractor or a JV member or Management Contractor or a sub-contractor, starting 1st April 2016 till 28 days prior to deadline of Tender submission.

S. No.	Starting Year	Ending Year	Contract Identification	Role of Tenderer [insert "Prime Contractor (single entity or JV member)" or Management Contractor or "Subcontractor"]
			Contract name: _____ Brief Description of the Works performed by the Tenderer: _____ Amount of contract: _____ Name of Employer: _____ Address: _____	
			Contract name: _____ Brief Description of the Works performed by the Tenderer: _____ Amount of contract: _____ Name of Employer: _____ Address: _____	

			Contract name: _____ Brief Description of the Works performed by the Tenderer: _____ Amount of contract: _____ Name of Employer: _____ Address: _____	
--	--	--	--	--

Tenderer’s Authorized Representative

Signature:

Date:

Company stamp:

Form EXP-3.4.2(a)**Specific Construction and Contract Management Experience**

[Ref. ITT Sub-Clause 17.2 and Section III, Evaluation and Qualification Criteria, Sub-Clause 3.4.2 (a)]

[The following table shall be filled in for the Tenderer or in case of JV, each member of a Joint Venture]

Tender No.: HORC/HRIDC/SYS-1/2023

Tenderer's Name: _____

JV Member's Name _____

Page _____ of _____ pages

Similar Contract No.	Information		
Contract Identification			
Award date			
Completion date			
Role in Contract as Prime Contractor or Member in JV or Management Contractor or Sub-Contractor	<i>[insert the role in Contract]</i>		
Total Contract Amount	<i>[insert Contract amount(s) and currency(ies)]</i>	INR <i>[insert *exchange rate and total Contract amount in INR equivalent]</i>	
If member in a JV or Sub-Contractor, specify participation in total Contract amount	<i>[insert Percentage participation]</i>	<i>[insert amount(s) and currency) of participation]</i>	<i>INR [insert exchange rate(i) and amount of participation in INR equivalent]</i>
Employer's Name (Owner of the Work):			
Address: Mobile: Telephone/fax number E-mail:			
Description of the similarity in accordance with Sub-Clause 3.4.2 (a) of Section III:			

1. Amount (in INR)	
2. supply, installation, testing & commissioning of 1 x 25kV or 2 x 25kV, Overhead Electrification (OHE) works (TKM)	
3. Traction Sub Station (TSS) 1 x 25kV or 2 x 25kV	

**Refer to Notes: Exchange Rate for Qualification Criteria, Section III, EQC.*

Tenderer's Authorized Representative

Signature:

Date:

Company stamp:

Notes:

- (i) *Value of completed work done by a Member in an earlier JV shall be reckoned only to the extent of the concerned member's share in that JV for purpose of satisfying his/her experience criteria mentioned in 3.4.2(a).*
- (ii) *The Tenderer shall submit copy of Completion Certificate /Provisional Completion Certificate/Provisional Acceptance Certificate (PAC) issued by the Employer (Owner of the Work) / Independent Engineer/ Concessionaire as documentary proof clearly indicating the similarity of the work as per Sub-Clause 3.4.2 (a), actual completion cost, actual completion date. Tenders submitted without this documentary proof shall not be evaluated.*
- (iii) *In case Tenderer submits work experience certificate issued by other than Govt. / Public Sector undertakings, the Tenderer shall also submit along with work experience certificate, the relevant copy of work order, bill of quantities, bill wise details of payment received duly certified by Chartered Accountant, TDS certificates for all payments received and copy of final/last bill paid by company in support of above work experience certificate.*
- (iv) *If a tenderer has successfully completed a work as Sub-Contractor, the work experience certificate issued only by the Employer (owner of the work)/Independent Engineer/ Concessionaire for such work to Sub-Contractor shall be considered for the purpose of fulfillment of credentials. Tenders submitted without this documentary proof shall not be evaluated.*

Form EXP-3.4.2(b) (i)**Specific Construction Experience in Key Activities**

[Ref. ITT Sub-Clause 17.2 and Section III, Evaluation and Qualification Criteria, Sub-Clause 3.4.2 (b) (i)]

[The following table shall be filled in for the Tenderer or in case of JV, each member of a Joint Venture]

Tender No.: HORC/HRIDC/SYS-1/2023

Tenderer's Name: _____

JV Member's Name _____

Page _____ of _____ pages

Similar Contract No.	Information		
Contract Identification			
Award date			
Completion date			
Role in Contract as Prime Contractor or Member in JV or Management Contractor or Sub-Contractor	<i>[insert the role in Contract]</i>		
Total Contract Amount	<i>[insert Contract amount(s) and currency(ies)]</i>		INR <i>[insert *exchange rate and total Contract amount in INR equivalent]</i>
If member in a JV or sub-contractor, specify participation in total Contract amount	<i>[insert Percentage participation]</i>	<i>[insert amount(s) and currency) of participation]</i>	INR <i>[insert exchange rate(i) and amount of participation in INR equivalent]</i>
Employer's Name (Owner of the Work):			
Address:			
Mobile:			
Telephone/fax number			
E-mail:			
Description of the similarity in accordance with Sub-Clause 3.4.2 (b) (i) of Section III:			

1. Supply, installation, testing & commissioning of 1 x 25kV/2x25kV, Overhead Electrification (OHE) works (TKM) in Railway / Metro Rail / RRTS / High Speed Rail/DFC projects	
--	--

**Refer to Notes: Exchange Rate for Qualification Criteria, Section III, EQC.*

Tenderer's Authorized Representative

Signature:

Date:

Company stamp:

Notes:

- (i) *For past experience of a firm in earlier JV for specified key activity in Sub-Clause 3.4.2 (b), credit shall be given for execution of that quantity of the specified key activity executed by the firm as per the Note 3 under Sub-Clause 3.4.2 (b).*
- (ii) *The Tenderer shall submit copy of certificates issued by the Employer (Owner of the Work) / Independent Engineer/ Concessionaire as documentary proof clearly indicating the completed quantities and actual completion date. OHE/TSS works in completed/ongoing contracts shall be considered only if Completion Certificate/Provisional Completion Certificate/Provisional Acceptance Certificate (PAC) has been issued by the Employer/Independent Engineer/Concessionaire for the quantities specified in Sub-Clause 3.4.2 (b). Tenders submitted without this documentary proof shall not be evaluated.*
- (iii) *In case Tenderer submits work experience certificate issued by other than Govt. / Public Sector undertakings, the Tenderer shall also submit along with work experience certificate, the relevant copy of work order, bill of quantities, bill wise details of payment received duly certified by Chartered Accountant, TDS certificates for all payments received and copy of final/last bill paid by company in support of above work experience certificate.*
- (iv) *If a tenderer has successfully completed a work as Sub-Contractor, the work experience certificate issued only by the Employer (owner of the work) /Independent Engineer/Concessionaire for such work to Sub-Contractor shall be considered for the purpose of fulfillment of credentials. Tenders submitted without this documentary proof shall be summarily rejected.*

Form EXP-3.4.2(b)(ii)**Specific Construction Experience in Key Activities**

[Ref. ITT Sub-Clause 17.2 and Section III, Evaluation and Qualification Criteria, Sub-Clause 3.4.2 (b) (ii)]

[The following table shall be filled in for the Tenderer or in case of JV, each member of a Joint Venture]

Tender No.: HORC/HRIDC/SYS-1/2023

Tenderer's Name: _____

JV Member's Name _____

Page _____ of _____ pages

Similar Contract No.	Information		
Contract Identification			
Award date			
Completion date			
Role in Contract as Prime Contractor or Member in JV or Management Contractor or Sub-Contractor	<i>[insert the role in Contract]</i>		
Total Contract Amount	<i>[insert Contract amount(s) and currency(ies)]</i>		INR <i>[insert *exchange rate and total Contract amount in INR equivalent]</i>
If member in a JV or sub-contractor, specify participation in total Contract amount	<i>[insert Percentage participation]</i>	<i>[insert amount(s) and currency) of participation]</i>	INR <i>[insert exchange rate(i) and amount of participation in INR equivalent]</i>
Employer's Name (Owner of the Work):			
Address:			
Mobile:			
Telephone/fax number			
E-mail:			
Description of the similarity in accordance with Sub-Clause 3.4.2 (b) (ii) of Section III:			
1. Supply, installation, testing & commissioning of Traction			

Sub-Station (TSS) (Nos.) in Railway / Metro Rail / RRTS / High Speed Rail/DFC projects	
--	--

**Refer to Notes: Exchange Rate for Qualification Criteria, Section III, EQC.*

Tenderer’s Authorized Representative

Signature:

Date:

Company stamp:

Notes:

- (i) *For past experience of a firm in earlier JV for specified key activity in Sub-Clause 3.4.2 (b), credit shall be given for execution of that quantity of the specified key activity executed by the firm as per the Note 3 under Sub-Clause 3.4.2 (b).*
- (ii) *The Tenderer shall submit copy of certificates issued by the Employer (Owner of the Work) / Independent Engineer/ Concessionaire as documentary proof clearly indicating the completed quantities and actual completion date. OHE/TSS works in completed/ongoing contracts shall be considered only if Completion Certificate/Provisional Completion Certificate/Provisional Acceptance Certificate (PAC) has been issued by the Employer/Independent Engineer/Concessionaire for the quantities specified in Sub-Clause 3.4.2 (b). Tenders submitted without this documentary proof shall not be evaluated.*
- (iii) *In case Tenderer submits work experience certificate issued by other than Govt. / Public Sector undertakings, the Tenderer shall also submit along with work experience certificate, the relevant copy of work order, bill of quantities, bill wise details of payment received duly certified by Chartered Accountant, TDS certificates for all payments received and copy of final/last bill paid by company in support of above work experience certificate.*
- (iv) *If a tenderer has successfully completed a work as Sub-Contractor, the work experience certificate issued only by the Employer (owner of the work) /Independent Engineer/Concessionaire for such work to Sub-Contractor shall be considered for the purpose of fulfillment of credentials. Tenders submitted without this documentary proof shall be summarily rejected.*

Appendix E to Technical Part: Tender Security

The amount for Tender Security in INR or the equivalent amount in a freely convertible currency will only be paid online by eligible Tenderers on eProcurement Portal of Government of Haryana.

OR

Tender Security can be submitted in the form of unconditional and irrevocable Bank Guarantee¹ in INR or the equivalent amount in a freely convertible currency from the banks specified in Sub-Clause ITT 19.3, Section II- TDS using the Tender Security Form given below.

Note: The rates of exchange for computing INR equivalent shall be the reference rate prevailing twenty-eight (28) days prior to the deadline of Tender submission. Exchange rates shall be taken from the sources specified in Note No. 1 (iii) given under Sub-Clause 3.4, Section III, EQC.

¹ Refer Sub-Clause ITT 1.3 H and Sub-Clause 19.3, Section II, TDS for submission of the Tender Security in the form of BG. Option of Exemption from payment of EMD mentioned in the module of eProcurement portal is only for exemption of online payment of Tender Security to the Tenderers who wish to submit Tender Security in the form of Bank Guarantee.

Tender Security Form of Demand Guarantee

Beneficiary:

Haryana Rail Infrastructure Development Corporation Limited,
Plot No 143, 5th Floor, Railtel Tower,
Sector-44, Gurugram, Haryana-122003

Tender No: HORC/HRIDC/SYS-1/2023

Date: _____ *[Insert date of issue of Demand Guarantee]*

TENDER SECURITY GUARANTEE No.: _____

Guarantor: *[Insert name and address of place of issue, unless indicated in the letterhead]*

We have been informed that _____ (hereinafter called "the Applicant") has submitted or will submit to the Beneficiary its Tender (hereinafter called "the Tender") for the execution of **“Contractor Package SYS-1: Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km (-) 2.099 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 315 TKM).”**

Furthermore, we understand that, according to the Beneficiary’s conditions, Tenders must be supported by a Tender guarantee.

At the request of the Applicant, we, as Guarantor, hereby irrevocably undertake to pay the Beneficiary any sum or sums not exceeding in total an amount of _____ (_____) upon receipt by us of the Beneficiary’s complying demand, supported by the Beneficiary’s statement, whether in the demand itself or a separate signed document accompanying or identifying the demand, stating that either the Applicant:

- (a) has withdrawn its Tender during the period of Tender validity set forth in the Applicant’s Letter of Tender (“the Tender Validity Period”), or any extension thereto provided by the Applicant; or
- (b) having been notified of the acceptance of its Tender by the Beneficiary during the Tender Validity Period or any extension thereto provided by the Applicant, (i) has failed to execute

the contract agreement, or (ii) has failed to furnish the Performance Security in accordance with the Instructions to Tenderers (“ITT”) of the Beneficiary’s Tender Document.

This guarantee will expire: (a) if the Applicant is the successful Tenderer, upon our receipt of copies of the contract agreement signed by the Applicant and the Performance Security issued to the Beneficiary in relation to such contract agreement; or (b) if the Applicant is not the successful Tenderer, upon the earlier of (i) our receipt of a copy of the Beneficiary’s notification to the Applicant of the results of the Tendering process; or (ii) twenty-eight days after the end of the Tender Validity Period.

Consequently, any demand for payment under this guarantee must be received by us at the office indicated above on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG) 2010 Revision, ICC Publication No. 758.

[signature(s)]

Form of Tender-Securing Declaration
DELETED

Letter of Tender – Financial Part

INSTRUCTIONS TO TENDERERS: DELETE THIS BOX ONCE YOU HAVE COMPLETED THE DOCUMENT

The Tenderer must prepare this Letter of Tender on stationery with its letterhead clearly showing the Tenderer's complete name and business address.

Note: All italicized text is to help Tenderers in preparing this form.

Date of this Tender submission: *[insert date (as day, month and year) of Tender submission]*

Tender No.: HORC/HRIDC/SYS-1/2023

To:

GM/IE&A,

Haryana Rail Infrastructure Development Corporation Limited (HRIDC),

Plot no.143, 5th floor,

Railtel Tower, Sector-44

Gurugram – 122003

Tel: +91 8860124749

We, the undersigned, hereby submit the second part of our Tender, the Tender Price and Price Schedule. This accompanies the Letter of Tender – Technical Part.

In submitting our Tender, we declare that:

- (a) **Tender Validity Period:** Our Tender shall be valid for the period specified in TDS 18.1 (as amended, if applicable) after the date fixed for the Tender submission deadline specified in TDS 22.1 (as amended, if applicable), and it shall remain binding upon us and may be accepted at any time before the expiration of that period;
- (b) ****Tender Price:** The total price of our Tender including Provisional Sum is: *[insert the total price of the Tender in words and figures in INR];*
- (c) **Commissions, Gratuities, Fees:** We have paid, or will pay the following commissions, gratuities, or fees with respect to the Tendering process or execution of the Contract: *[insert complete name of each Recipient, its full address, the reason for which each commission or gratuity was paid and the amount and currency of each such commission or gratuity]*

Name of Recipient	Address	Reason	Amount

(If none has been paid or is to be paid, indicate “none.”)

Name of the Tenderer: *[insert complete name of the Tenderer]*

Name of the person duly authorized to sign the Tender on behalf of the Tenderer: **[insert complete name of person duly authorized to sign the Tender]*

Title of the person signing the Tender: *[insert complete title of the person signing the Tender]*

Signature of the person named above: *[insert signature of person whose name and capacity are shown above]*

Date signed *[insert date of signing]* **day of** *[insert month]*, *[insert year]*

*: Person signing the Tender shall have the power of attorney given by the Tenderer. The power of attorney shall be attached with the Letter of Tender.

** The total price of Tender including Provisional Sums quoted in this Letter of Tender-Financial Part shall be same as given in Worksheet BOQ3 (Price Schedule –Summary Sheet) of MS-Excel File which includes cost of Schedule ‘A’ plus Schedule ‘B’ and plus Provisional Sum.

Appendix A to Financial Part: Schedule of Adjustment Data

1. Price adjustment

- 1.1 The amounts payable to the Contractor for Works shall be adjusted in accordance with the provisions of this Clause 1.0, Sub-Clause 13.7 of GCC and Sub-Clause 13.7, Specific Provision, Part B, Section IX-PCC.
- 1.2 The Contract Price shall be adjusted for increase or decrease in rates and prices of labour, materials, Electrical equipment and other commodities or inputs in accordance with the principles, procedures and formulae specified below:
- a) Base month for the purpose of Price Adjustment shall be the month in which the Tender is opened. The 1st Quarter will start from Base month;
 - b) For Schedule-A, Price adjustment shall be applied on completion of the specified stage of the respective item of work.

The following expressions and meanings are assigned to the Cost Centre of Price Schedule ‘A’:

Cost Centre	Description of Cost Centre	Price Adjustment
1	2	3
E1	Surveys, Investigation, Studies, Design and Documents, O & M Manuals, As Built Drawings and Training of staffs	Not Applicable
E2	OHE Works	Applicable
E3	Traction Substations (TSS)	Applicable
E4	Sectioning Post (SP)	Applicable
E5	Sub Sectioning Post (SSP)	Applicable
E6	SCADA	Applicable
E7	Spares and Tools	Applicable only for Sub Cost Centre E7.1 & E7.2
E8	Annual Maintenance contract for 3 Years	Not Applicable

- c) **The following expressions and meanings are assigned to the value of the work done for electrification works under Price Schedule ‘A’:**
- i) OHE = Value of work done for the completion of a stage under cost Centre ‘E2- Overhead Equipment Work’ of Price Schedule ‘A’;
 - ii) TSS = Value of work done for the completion of a stage under cost Centre ‘E3- Traction Sub-Station’ of Price Schedule ‘A’;
 - iii) SP = Value of work done for the completion of a stage under cost Centre ‘E4 - Sectioning Posts (SP)’ of Price Schedule ‘A’;
 - iv) SSP = Value of work done for the completion of a stage under cost Centre ‘E5 - Sub Sectioning Posts (SSP)’ of Price Schedule ‘A’;

- v) SCADA = Value of work done for the completion of a stage under cost Centre ‘E6-SCADA’ of Price Schedule ‘A’;
- vi) SPARES = Value of work done for the completion of a stage under Sub Cost Centre ‘E7.1-Supply of spares for OHE works’ & ‘E7.2-Supply of spares for Traction Power Installation’ of Price Schedule ‘A’;
- d) Price adjustment for changes in cost for electrification works under Price Schedule ‘A’ shall be paid in accordance with the following formula:**
- i) **VOHE** = $0.85 \text{ OHE} \times [\text{PLB} \times (\text{LBi} - \text{LBo})/\text{LBo} + \text{PC} \times (\text{Ci} - \text{Co})/\text{Co} + \text{PSST} \times (\text{SSTi} - \text{SSTo})/\text{SSTo} + \text{PCU} \times (\text{CUi} - \text{CUo})/\text{CUo} + \text{PINS} \times (\text{INSi} - \text{INSo})/\text{INSo}] + \text{PSWGR} \times (\text{SWGRi} - \text{SWGRo})/\text{SWGRo}; + \text{POTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}$
- ii) **VTSS** = $0.85 \text{ TSS} \times [\text{PLB} \times (\text{LBi} - \text{LBo})/\text{LBo} + \text{PTR} \times (\text{TRi} - \text{TRo})/\text{TRo} + \text{PC} \times (\text{Ci} - \text{Co})/\text{Co} + \text{PSST} \times (\text{SSTi} - \text{SSTo})/\text{SSTo} + \text{PSWGR} \times (\text{SWGRi} - \text{SWGRo})/\text{SWGRo} + \text{POTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}];$
- iii) **VSP** = $0.85 \text{ SP} \times [\text{PLB} \times (\text{LBi} - \text{LBo})/\text{LBo} + \text{PC} \times (\text{Ci} - \text{Co})/\text{Co} + \text{PSWGR} \times (\text{SWGRi} - \text{SWGRo})/\text{SWGRo} + \text{PSST} \times (\text{SSTi} - \text{SSTo})/\text{SSTo}] + \text{POTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}$
- iv) **VSSP** = $0.85 \text{ SP} \times [\text{PLB} \times (\text{LBi} - \text{LBo})/\text{LBo} + \text{PC} \times (\text{Ci} - \text{Co})/\text{Co} + \text{PSWGR} \times (\text{SWGRi} - \text{SWGRo})/\text{SWGRo} + \text{PSST} \times (\text{SSTi} - \text{SSTo})/\text{SSTo} + \text{POTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}]$
- v) **VSCADA** = $0.85 \text{ SCADA} \times [\text{PLB} \times (\text{LBi} - \text{LBo})/\text{LBo} + \text{PELEX} \times (\text{ELEXi} - \text{ELEXo})/\text{ELEXo} + \text{POTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}];$
- vi) **VSPARE** = $0.85 \text{ SPARE} \times \text{PSST} \times (\text{SSTi} - \text{SSTo})/\text{SSTo} + \text{PCU} \times (\text{CUi} - \text{CUo})/\text{CUo} + \text{PINS} \times (\text{INSi} - \text{INSo})/\text{INSo}] + \text{PSWGR} \times (\text{SWGRi} - \text{SWGRo})/\text{SWGRo}; + \text{PTR} \times (\text{TRi} - \text{TRo})/\text{TRo} + [\text{POTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}];$

Where:-

VOHE = Increase or decrease in the cost under cost centre ‘E2’ of Price Schedule ‘A’ of Over Head Equipment and other related works during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (e);

VTSS = Increase or decrease in the cost under cost centre ‘E3’ of Price Schedule ‘A’ of Traction Sub-Station and other related works during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (e);

VSP = Increase or decrease in the cost under cost centre ‘E4’ of Price Schedule ‘A’ of Sectioning Post (SP) and other related works during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (e);

VSSP = Increase or decrease in the cost under cost centre ‘E5’ of Price Schedule ‘A’ of Sub Sectioning Post (SSP) and other related works during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (e);

VSCADA = Increase or decrease in the cost under cost centre ‘E6’ of Price Schedule ‘A’ of SCADA and related works during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (e);

VSPARE = Increase or decrease in the cost under Sub Cost Centre ‘E7.1-Supply of spares for OHE works’ & ‘E7.2-Supply of spares for Traction Power Installation’ of Price Schedule ‘A’ during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (e);

PLB, PC, PSST, PCU, PINS, PSWGR, PTR, PELEX, and POTH are the percentages of Labour, Cement, Structural Steel, Copper Wire, Insulators, Electrical Switch Gears, Transformer, Electronic Items and All Other Commodities respectively for the relevant item as specified in sub-paragraph (e);

LBo = The consumer price index for industrial workers – All India, published by Labour Bureau, Ministry of Labour, Government of India, (hereinafter called “CPI”) for the Base month;

LBi = The CPI for industrial workers – All India for the average price index of the 3 months of the quarter under consideration

Co = The wholesale Price Index as published by the Ministry of Commerce & Industry, Government of India (hereinafter called “WPI”) for cement, lime, plaster for the Base month;

Ci = The WPI for cement, lime, plaster for the average price index of the 3 months of the quarter under consideration.

SSTo= Price of BLOOMS –Retail (SBLR) 150mmx150mm published by IEEMA for the Base month;

SSTi = = Price of BLOOMS –Retail (SBLR) 150mmx150mm published by IEEMA for the average price index of the 3 months of the quarter under consideration;

CUo= Copper: (CU) Price of Copper Wire Rod published by IEEMA for the Base month;

CUi = Copper: (CU) Price of Copper Wire Rod published by IEEMA for the average price index of the 3 months of the quarter under consideration;

INSo = The WPI for insulators for the Base month;

INSi = The WPI for insulators for the average price index of the 3 months of the quarter under consideration;

SWGRo = The WPI for MANUFACTURE OF ELECTRICAL EQUIPMENT for the Base month;

SWGRi = The WPI for MANUFACTURE OF ELECTRICAL EQUIPMENT for the average price index of the 3 months of the quarter under consideration;

TRo= The WPI for transformers for the Base month;

TRi= The WPI for transformers for the average price index of the 3 months of the quarter under consideration.

ELEXo = The WPI for MANUFACTURE OF ELECTRONIC COMPONENTS electronic items for the Base month;

ELEXi = The WPI for MANUFACTURE OF ELECTRONIC COMPONENTS for the average price index of the 3 months of the quarter under consideration;

OTHo = The WPI for all commodities for the Base month;

OTHi = The WPI for all commodities for the average price index of the 3 months of the quarter under consideration;

- e) **The following percentages shall govern the price adjustment of the Contract Price for electrification works:**

Component	SCHEDULE 'A'					
	OHE (Cost Centre E2)	TSS (Cost Centre E3)	SP (Cost Centre E4)	SSP (Cost Centre E5)	SCADA (Cost Centre E6)	Spares (Sub Cost Centre E 7.1 & E 7.2)
Labour (PLB)	10%	2.3%	5.2%	6%	14%	-
Cement (PC)	10%	3%	3%	4%	-	-
Structural steel (PSST)	31%	2.5%	3.8%	5%	-	8%
Insulators (PINS)	6.5%	-	-	-	-	4%
Copper wire (PCU)	35%	-	-	-	-	12%
Transformer (PTR)	0.5%	72.5%	55%	48%	-	15%
Electrical Switch Gear (PSWGR)	-	9.5%	16%	27%	-	12%
Electronic (PELEX)	-	-	-	-	76%	-
All other commodities (POTH)	7%	11.2%	17%	14%	10%	49%
Total	100%	100%	100%	100%	100%	100%

- f) The following expressions and meanings are assigned to Sub Schedules under Price Schedule ‘B’:

Sub Schedule	Description of Sub Schedule Cost	Price Adjustment
1	2	3
B1	General	Applicable
B2	Concrete	Applicable
B3	Ferrous	Applicable
B4	Non Ferrous	Applicable
B5	Catenary & Contact wire	Applicable
B6	Insulators	Applicable
B7	SCADA at Harsana Kalan IR SSP	Applicable
B8	Non Schedule (NS) Items	Not Applicable

- g) **The following expressions and meanings are assigned to the value of the work done for electrification works under Price Schedule ‘B’:**

- i) **GEN** = Value of work done for the completion of a stage under Sub Schedule ‘B1 -General’ of Price Schedule ‘B’;
- ii) **CON** = Value of work done for the completion of a stage under Sub Schedule ‘B2 -Concrete’ of Price Schedule ‘B’;
- iii) **FER** = Value of work done for the completion of a stage under Sub Schedule ‘B3 -Ferrous’ of Price Schedule ‘B’;
- iv) **NFER** = Value of work done for the completion of a stage under Sub Schedule ‘B4 -Non-Ferrous’ of Price Schedule ‘B’;
- v) **CATCO** = Value of work done for the completion of a stage under Sub Schedule ‘B5 - Catenary and contact’ of Price Schedule ‘B’;
- vi) **INS** = Value of work done for the completion of a stage under Sub Schedule ‘B6 -Insulators’ of Price Schedule ‘B’;
- vii) **SCADA** = Value of work done for the completion of a stage under Sub Schedule ‘B7-SCADA’ of Price Schedule ‘B’;

- h) **Price adjustment for changes in cost for electrification works under Price Schedule ‘B’ shall be paid in accordance with the following formula:**

- i)
$$\mathbf{VGEN} = 0.85 \text{ GEN} \times [\text{PLB} \times (\text{LBi} - \text{LBo})/\text{LBo} + \text{PSST} \times (\text{SSTi} - \text{SSTo})/\text{SSTo} + \text{PCU} \times (\text{CUi} - \text{CUo})/\text{CUo} + \text{PSWGR} \times (\text{SWGRi} - \text{SWGRo})/\text{SWGRo}] + \text{POTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}]$$
- ii)
$$\mathbf{VCON} = 0.85 \text{ CON} \times [\text{PLB} \times (\text{LBi} - \text{LBo})/\text{LBo} + \text{PC} \times (\text{Ci} - \text{Co})/\text{Co} + \text{OTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}]$$
- iii)
$$\mathbf{VFER} = 0.85 \text{ FER} \times [\text{PLB} \times (\text{LBi} - \text{LBo})/\text{LBo} + \text{PSST} \times (\text{SSTi} - \text{SSTo})/\text{SSTo} + \text{POTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}]$$

- iv) **VNFER** = $0.85 \text{ NFER} \times [\text{PLB} \times (\text{LBi} - \text{LBo})/\text{LBo} + \text{PINS} \times (\text{INSi} - \text{INSo})/\text{INSo} + \text{PCU} \times (\text{CUi} - \text{CUo})/\text{CUo} + \text{PSWGR} \times (\text{SWGRi} - \text{SWGRo})/\text{SWGRo} + \text{POTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}]$
- v) **VCATCO** = $0.85 \text{ CATCO} \times [\text{PCU} \times (\text{CUi} - \text{CUo})/\text{CUo}]$;
- vi) **VINS** = $0.85 \text{ INS} \times [\text{PINS} \times (\text{INSi} - \text{INSo})/\text{INSo}]$;
- vii) **VSCADA** = $0.85 \text{ SCADA} \times [\text{PLB} \times (\text{LBi} - \text{LBo})/\text{LBo} + \text{PELEX} \times (\text{ELEXi} - \text{ELEXo})/\text{ELEXo} + \text{POTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}]$;

Where:-

VGEN = Increase or decrease in the cost under Sub Schedule ‘B1-General’ of Price Schedule ‘B’ during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (i);

VCON = Increase or decrease in the cost under Sub Schedule ‘B2-Concrete’ of Price Schedule ‘B’ during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (i);

VFER = Increase or decrease in the cost under Sub Schedule ‘B3-Ferrous’ of Price Schedule ‘B’ during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (i);

VNFER = Increase or decrease in the cost under Sub Schedule ‘B4-Non-Ferrous’ of Price Schedule ‘B’ during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (i);

VCATCO = Increase or decrease in the cost under Sub Schedule ‘B5-Catenary and Contact Wire’ of Price Schedule ‘B’ during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (i);

VINS = Increase or decrease in the cost under Sub Schedule ‘B6-Insulators’ of Price Schedule ‘B’ during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (i);

VSCADA = Increase or decrease in the cost under Sub Schedule ‘B7-SCADA’ of Price Schedule ‘B’ during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (i);

PLB, PC, PSST, PCU, PINS, PSWGR, PELEX and POTH are the percentages of Labour, Cement, Structural Steel, Copper Wire, Insulators, Electrical Switch Gears, Electronic Items and All Other Commodities respectively for the relevant item as specified in sub-paragraph (i);

LBo = The consumer price index for industrial workers – All India, published by Labour Bureau, Ministry of Labour, Government of India, (hereinafter called “CPI”) for the Base month;

LBi = The CPI for industrial workers – All India for the average price index of the 3 months of the quarter under consideration

Co = The Wholesale Price Index as published by the Ministry of Commerce & Industry, Government of India (hereinafter called “WPI”) for cement, lime, plaster for the Base month;

Ci = The WPI for cement, lime, plaster for the average price index of the 3 months of the quarter under consideration.

SSTo= Price of BLOOMS –Retail (SBLR) 150mmx150mm published by IEEMA for the Base month;

SSTi = = Price of BLOOMS –Retail (SBLR) 150mmx150mm published by IEEMA for the average price index of the 3 months of the quarter under consideration;

CUo= Copper : (CU) Price of Copper Wire Rod published by IEEMA for the Base month;

CUi = Copper : (CU) Price of Copper Wire Rod published by IEEMA for the average price index of the 3 months of the quarter under consideration;

INSo = The WPI for insulators for the Base month;

INSi = The WPI for insulators for the average price index of the 3 months of the quarter under consideration;

SWGRo = The WPI for MANUFACTURE OF ELECTRICAL EQUIPMENT for the Base month;

SWGRi = The WPI for MANUFACTURE OF ELECTRICAL EQUIPMENT for the average price index of the 3 months of the quarter under consideration;

ELEXo = The WPI for MANUFACTURE OF ELECTRONIC COMPONENTS electronic items for the Base month;

ELEXi = The WPI for MANUFACTURE OF ELECTRONIC COMPONENTS for the average price index of the 3 months of the quarter under consideration;

OTHo = The WPI for all commodities for the Base month;

OTHi = The WPI for all commodities for the average price index of the 3 months of the quarter under consideration;

- i) The following percentages shall govern the price adjustment of the Contract Price for electrification works under Schedule 'B':

Component	SCHEDULE 'B'						
	General (B1)	Concrete (B2)	Ferrous (B3)	Non-Ferrous (B4)	Catenary and Contact wire (B5)	Insulators (B6)	SCADA (B7)
Labour (PLB)	23%	20%	6%	7%	0%	0%	10%
Cement (PC)	0%	70%	0%	0%	0%	0%	0%
Structural steel (PSST)	20%	0%	90%	0%	0%	0%	0%
Insulators (PINS)	0%	0%	0%	10%	0%	100%	0%
Copper wire (PCU)	20%	0%	0%	20%	100%	0%	0%
Electrical Switch Gear (PSWGR)	20%	0%	0%	50%	0%	0%	0%
Electronic (PELEX)	0%	0%	0%	0%	0%	0%	80%
All other commodities (POTH)	17%	10%	4%	13%	0%	0%	10%
Total	100%	100%	100%	100%	100%	100%	100%

Table A. Foreign Currency (FC)

Not applicable as Tenderers are required to quote rates and prices only in INR.

Table B. Summary of Payment Currencies

For [insert name of Works]

Name of Payment Currency	A	B	C	D
	Amount of Currency	Rate of Exchange (local currency per unit of foreign)	Local Currency Equivalent $C = A \times B$	Percentage of Net Tender Price (NTP) $\frac{100 \times C}{NTP}$
For Schedule 'A'				
Local currency (INR)		1.00		
Foreign Currency #1 _____				
Foreign Currency #2 _____				
Foreign Currency #3 _____				
For Schedule 'B' expressed in Local currency (INR)		1.00		
Net Tender Price				100.00
Provisional Sums Expressed in Local Currency (INR) in million	100,000,000.00	1.00	100,000,000.00	Not Applicable
TOTAL TENDER PRICE (including provisional sum)				

Note: *The Tenderer is required to propose and submit the schedules given in tables above as part of the Tender. The rates of exchange shall be the reference rate twenty-eight (28) days prior to the deadline for submission of Tenders published by the Reserve Bank of India (RBI) on its website <https://www.rbi.org.in> . In case the exchange rate of particular currency on given date is not available on RBI web site, it will be as per the web site <https://www.fbil.org.in> of Financial Benchmark India Private Limited (FBIL). In the case, where a Tenderer is required to convert a monetary amount from a currency other than those currencies for which the RBI/FBIL reference rate is not published, the INR equivalent shall be worked out using the rate of exchange as published by the central bank of the country issuing the said currency. In case the exchange rate of that currency is not directly available in INR on the website of the central bank of the country issuing the said currency then the currency will be first converted to USD as per that web site and then converted from USD to INR as Per RBI or FBIL reference rates.*

Appendix B to Financial Part: Price Schedules

I Preamble

- 1.1. The Price Schedules shall be read in conjunction with the Instructions to Tenderers, the General Conditions, the Particular Conditions and the Employer's Requirements (General Specifications, Particular Specifications, Tender Drawings, ESHS manual) and the Addenda/Corrigenda (if any).
- 1.2. **Schedule 'A'** comprises scope of work to be executed under lump sum contract as detailed in Part 2- Employers' Requirements of Tender Document. The Tenderer has to quote a single lump sum amount against Schedule 'A'. Payment to the Contractor will be made in accordance with payment stages/Milestones defined for each Cost Centre detailed in Clause 5.0 below unless otherwise specified in the Contract.
- 1.3. **Schedule 'B'** comprises of items for "PSI works for IR Connectivity at New Prithla, Sultanpur, Asaudah, New Harsana Kalan, feeder from Harsana Kalan IR SSP to New Harsana Kalan OHE. The work has to be carried out as per the description of items given in Schedule 'B' and directions of the Engineer. Cost of design and drawings of all the temporary works, temporary road diversion is deemed to be included in the rates quoted for the relevant item of Schedule 'B' unless otherwise specified in the Contract. Schedule 'B' is further divided into eight Sub-Schedules i.e. Schedule 'B1', Schedule 'B2', Schedule 'B3', Schedule 'B4', Schedule 'B5', Schedule 'B6', Schedule 'B7' and Schedule 'B8'. The Tenderer has to quote the percentage Excess (+) or Less (-) over the total Estimated amount of Schedule 'B1', Schedule 'B2', Schedule 'B3', Schedule 'B4', Schedule 'B5', Schedule 'B6', Schedule 'B7' and Schedule 'B8' (which is shown as "Estimated Rate" against each Schedule in BOQ2 of MS excel file on eProcurement portal). The payment against this Schedule 'B' will be made on the basis of quantities executed, measured and certified. Under this Schedule, the Contractor is required to carry out other electrification works, which are not covered in Schedule 'A', as per site requirements and as per the direction of the Engineer.
- 1.4. The Schedules may not generally give a full description of the works to be performed and the plant or equipment to be supplied under each item. Tenderers shall be deemed to have read the Employer's Requirements and the other sections of the Tender Documents and reviewed the Drawings to ascertain the full scope of the requirements included in each item prior to filling the rates and prices.
- 1.5. The price quoted in the Price Schedules for Schedule 'A' and Schedule 'B' are for complete and finished items of the work in all respects. The Price quoted in the Price Schedule shall, except otherwise specifically provided, shall include all design, manufacture, supply, installation, testing commissioning and include all necessary survey work, plants, tools, machinery, Contractor's equipment, labour, compliance of labour laws, supervision, materials, transportation, handling, loading & unloading, storage, sampling, inspection, testing, fuel, oil, consumables, electric power, water, all leads & lifts, dewatering, all temporary works including temporary accesses, staging, form works and false works, stacking, provision and maintenance of all temporary works area, construction of temporary store and buildings, fencing, barricading, lighting, drainage

arrangements, erection & maintenance of inspection facilities above and below ground such as brick, concrete and steel etc., reinstatement, remedy of any defects during the Defects Notification Period, safety measures for workmen and road users, preparation of design and drawings pertaining to permanent and temporary works, & temporary diversion works, traffic diversion works, mobilisation and demobilisation, establishment and overhead charges, labour camps, insurance cost for labour and works, contractor's profit, all taxes including Goods and Service Tax (GST), insurance, royalties, duties, cess, octroi, other levies and other charges together with all general risks, liabilities and obligations set out or implied in the Contract.

- 1.6. The whole cost of complying with the provisions of the Contract shall be included in the items provided in the Price Schedule, and where no items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related items of the Work.
- 1.7. To the extent acceptable to the Employer for the purpose of making payments or partial payments, valuing variations or evaluating claims, or for such other purposes as the Engineer may reasonably require, the Contractor may provide the Engineer with a breakdown of any composite or lump sum items included in the Schedules.
- 1.8. The Provisional Sums included and so designated in the Price Schedules shall be expended in whole or in part at the direction and discretion of the Engineer. The Provisional Sum shall be used to cover the Employer's share of the DAAB members' fees and expenses, in accordance with Clause 21. No prior instruction of the Engineer shall be required with respect to the work of the DAAB in accordance with Sub-Clause 13.4 of Part B-Specific Provisions - Particular Conditions of Contract. The Contractor shall submit the DAAB members' invoices and satisfactory evidence of having paid 100% of such invoices as part of the substantiation of those statements submitted under Sub-Clause 14.3. in accordance with Sub-Clauses 13.4 of the General Conditions.
- 1.9. The prices shall be quoted against Schedule 'A' and Schedule 'B' in the Price Schedule (Excel Workbook) uploaded on the eProcurement portal.
- 1.10. The prices quoted shall be comprehensive and must include for complying in all respects with the Price Schedule, Instruction to Tenderers, the General Conditions, the Particular Conditions, Employer's Requirements, Specifications and Drawings and for all matters and things necessary for the proper design, manufacture, supply, installation, testing commissioning, completion, and making good of any defect in part or of the whole of the Works.
- 1.11. No claims for additional payment shall be allowed for any error or misunderstanding by the Contractor of the work involved.

2 Variations in Price Schedule 'A' and Schedule 'B'

- 2.1 Variations in Price Schedules shall be dealt in accordance with Sub Clause 13.3 of Section VIII- General Conditions of Contract and Section IX- Particular Conditions of Contract.
- 2.2 The through Chainages mentioned in the Scope of the Works/Tender Drawings can undergo some

minor corrections, without any impact on the overall length/Scope of the Works.

3 Measurement and Payment

- 3.1 The measurement shall be made as per Price Schedules i.e. Schedule 'A', Schedule 'B' and other relevant provisions of the Contract such as Employer's Requirements and the Drawings.
- 3.2 If during execution of the Contract, it is decided by the Employer/Engineer that one or more items of Work/Milestone of a Cost Centre in a particular Price Schedule is not required to be executed, the proportionate amount against that particular Item of Work/Milestones shall not be paid. The Engineer's decision in this regard shall be final.
- 3.3 The Payment shall be made as per Clause 14 [Contract Price and Payment] of the General Conditions and Particular Conditions.
- 3.4 The Employer shall make interim payments to the Contractor in accordance with the provisions of Sub-Clause 14.6 [Issue of Interim Payment Certificates] of the General Conditions and Particular Conditions, as certified by the Engineer on the basis of the progress achieved for the items of works/stages/Milestones of the works.
- 3.5 The Contractor shall base its claim for interim payment in accordance with Sub-Clause 14.3 [Application for Interim Payment] of the General Conditions and Particular Conditions for each stage for various items of work on the basis of actual progress of work executed (i.e. Milestones achieved) till the end of the month for which the payment is claimed in relation to the Contractor's total executed quantity, supported with documents and updated programme in accordance with the Employer's Requirements.
- 3.6 The Employer may carry out necessary tests, either directly or through an independent agency, of the Works done by the Contractor for which payment has been accepted and certified by the Engineer. The payment shall depend upon the outcome of such tests.
- 3.7 Format for the Contractor's application for payment shall be agreed between the Engineer and the Contractor.
- 3.8 All necessary supplementary details to support progress claims, including all certified Request for Inspection in hard bound copy, shall be included with application for payment. Sketches, drawings, approvals, calculations, test reports etc. shall accompany an application for payment to be substantiated and certified by the Engineer and submitted to the Employer.
- 3.9 Even if no work is executed during the month, or the Contractor does not choose to issue an application for payment, a 'NIL' application shall be submitted.
- 3.10 For the purposes of payment, the Contractor shall submit to the Engineer a detailed Price Schedule indicating a further breakdown for each stage of payment contained in the Price Schedules within forty-two (42) days after the receipt of the Letter of Acceptance. Such cost breakdowns shall be subject to approval of the Engineer who shall review and evaluate with comments and/or issue approval within twenty-eight (28) days of receipt of same. The Contractor shall resubmit the cost breakdown structure corresponding to the Engineer's comments for review, if required.

3.11 The Engineer is not obliged to issue an Interim Payment Certificate until such breakdown structure of payment schedule has been submitted and accepted by the Engineer.

4 Methodology for Claiming Payment

4.1 The Contractor shall prepare his monthly application for payment in the agreed format in six hard copies and one soft copy. This shall be accompanied by supplementary details in accordance with Sub-Clause 14.3 [Application for Interim Payment Certificates] of the General Conditions. All hard copies shall bear the original signatures of the Contractor's Representative and be submitted to the Engineer.

4.2 If these are found in order, in accordance with Sub-Clause 14.6 [Issue of Interim Payment Certificates] of the General Conditions, then the Engineer shall forward three certified copies of the application along with certified supplementary details to the Employer, with his recommendation for payment; otherwise, all documents shall be returned to the Contractor for rectification and resubmission.

5 Price Schedules

5.1 Schedule "A"- Breakup of Lump Sum cost of Electrification Works under various Sub-Heads shall be as follows:

Sub-Head	Description	Percentage of the quoted lump sum cost of Schedule 'A'	No. of Cost Centre	Total Cost of each Sub-Head
1	2	3	4	5
E	Electrification Works	100	8	E= 1xLS*

*LS = Total lump sum accepted cost of Works for Schedule 'A'

5.2 Apportionment of Contract Price for payments under various Cost Centre for Sub-Head 'E'- Electrification Works

Cost Centre	Description of Cost Centre	Percentage (%) of Cost Centre 'E'	Total Cost of Cost Centre	Total Cost of Sub-Head 'E'
1	2	3	4	5
E1	Surveys, Investigation, Studies, Design and Documents, O & M Manuals, As Built Drawings and Training of staffs	3.57	E1= 0.0357x 'E'	100% of SCH 'A'
E2	OHE Works	55.87	E2=0.5587x 'E'	
E3	Traction Substations (TSS)	17.00	E3=0.17x 'E'	
E4	Sectioning Post (SP)	5.67	E4=0.0567x 'E'	
E5	Sub Sectioning Post (SSP)	5.33	E5=0.0533x 'E'	

E6	SCADA	1.05	$E6=0.0105x 'E'$	
E7	Spares and Tools	3.63	$E7=0.0363x 'E'$	
E8	Annual Maintenance contract for 3 Years	7.88	$E8= 0.0788x 'E'$	
Total		100%		

Note: Value of 'E' shall be as defined in Sub-Clause 5.1 above.

The percentage figures as filled in column (3) for the apportionment of the Contract Price for completion of the Works corresponding to the various Sub-Heads and Cost Centres are fixed and payment will be released for different Cost centre as per above percentage break-up of Contract Price.

5.2.1 Stages of Payment i.e. Milestones of Cost Centre 'E1'- Survey, Investigations, Management plans, Studies, Design & documents, O&M manual and as built drawings, training of staff

Cost Centre		Survey, Investigations, Management plans, Studies, Design & documents, O&M manual and as built drawings, training of staff		
Weightage of Cost Centre 'E1', (X)		3.57%		
Sub Cost Centre	Item of Work		Milestones	Weightage (Y) (%)
	No.	Description		
E 1.1 Surveys of entire section for OHE & ROCS Works	E1.1.1	Surveys of entire section detailing all utilities and Geo-Technical investigations for, 2x25 kV AC Traction Electrification, ROCS in Tunnel, Viaduct, Major Bridge, Transmission Lines and associated works	Surveys of entire section detailing all utilities and Geo-Technical investigations for, 2x25 kV AC Traction Electrification, ROCS in Tunnel, Viaduct, Major Bridge, Transmission Lines and associated works	2
E1.2 Preliminary design & Documents	E1.2.1	Submission and approval of Inception Report including Design manual	Submission and approval of Inception Report including Design manual	2
	E1.2.2	Submission and approval of System Requirement Specification (SRS)	Submission and approval of System Requirement Specification (SRS)	3
	E1.2.3	Submission and approval of Management Plans	Submission and approval of Management Plans	5
	E1.2.4	Traction Simulation study report	Traction Simulation study report	6
	E1.2.5	Traction power Supply system design with supportive calculations	Traction power Supply system design with supportive calculations	4
	E1.2.6	OHE Works with supportive calculations	OHE Works with supportive calculations	4
	E1.2.7	Earthing & Bonding scheme	Earthing & Bonding scheme	2
	E1.2.8	ROCS works	ROCS works	2
	E1.2.9	SCADA System	SCADA System	2

Cost Centre	Survey, Investigations, Management plans, Studies, Design & documents, O&M manual and as built drawings, training of staff			
Weightage of Cost Centre 'E1', (X)	3.57%			
Sub Cost Centre	Item of Work		Milestones	Weightage (Y) (%)
	No.	Description		
E1.3 Detailed Design & Documents	Submission and approval of Detailed Design & Documents for Electrical works including layout Plans, Design Manuals and GFC(Good for Construction Drawings) and other Construction Reference Drawings like Combined Service Drawing etc.			
	E1.3.1	OHE Works	OHE Works	15
	E1.3.2	Traction Power Supply Works	Traction Power Supply Works	25
	E1.3.3	ROCS Works	ROCS Works	4
	E1.3.4	Traction and Auxiliary SCADA works	Traction and Auxiliary SCADA works	5
E1.4 As Built Drawings	E1.4.1	Submission and approval of As-Built Drawings for Completed works	Submission and approval of As-Built Drawings for Completed works	6
E 1.5 Operation & Maintenance Manuals	E1.5.1	Submission & Approval of Operation & Maintenance Manuals	Submission & Approval of Operation & Maintenance Manuals	3
E1.6 RAMS Plan	E1.6.1	RAMS Demonstration tests, reports, Establishing FRACAS and Defect Notification stage RAMS Plan	RAMS Demonstration tests, reports, Establishing FRACAS and Defect Notification stage RAMS Plan	3
E 1.7 Miscellaneous	E1.7.1	Any other design compliance and document required to be prepared as part of the contract	Any other design compliance and document required to be prepared as part of the contract	2
E1.8 Training	E1.8.1.	Training	Training	4
E1.9 Permits and approvals	E1.9.1	Obtaining permits and approvals as required from various Statutory & Government Bodies	Obtaining permits and approvals as required from various Statutory & Government Bodies	1

Cost Centre	Survey, Investigations, Management plans, Studies, Design & documents, O&M manual and as built drawings, training of staff			
Weightage of Cost Centre 'E1', (X)	3.57%			
Sub Cost Centre	Item of Work		Milestones	Weightage (Y) (%)
	No.	Description		
			Total	100.00

Notes:

- 1 The value of each Milestones will be total lump sum accepted cost of Works for Schedule 'A' (LS) multiplied by X * Y. For example, the value of Milestone E1.1.1 will be equal to $LS * X * Y = LS * 0.0357 * 0.02$.
- 2 Adjustment to Contract Price pursuant to GCC 13.7 shall NOT be applicable to the payments of Works executed under this Cost Centre.
- 3 Payment will be made on completion of each Milestone as per weightage given in this Cost Centre.

5.2.2 Stages of Payment i.e. Milestones of Cost Centre 'E2'- OHE Works

Cost Centre		OHE Works		
Weightage of Cost Centre 'E2', (X)		55.87%		
Sub Cost Centre	Item of work		Milestone	Weightage (Y) (%)
	No	Description		
E.2.1 Contact Wire	E 2.1.1	Supply of Contact Wire	Supply of Contact Wire	15.63
E.2.2 Catenary Wire	E 2.2.1	Supply of Catenary Wire	Supply of Catenary Wire	13.43
E2.3 Feeder wire	E 2.3.1	Supply of Feeder conductor (NFW)	Supply of Feeder conductor (NFW)	1.72
E2.4 Steel Structure	E 2.4.1	Supply Galavanised steel structure, Traction Mast and Portal and SPS including Guy Rod Assembly	Supply Galavanised steel structure, Traction Mast and Portal and SPS including Guy Rod Assembly	20.46
E2.5 Cantilever Assembly	E 2.5.1	Supply of Cantilever Assembly without Insulator	Supply of Cantilever Assembly without Insulator	6.98
E2.6 Auto Tension Device	E 2.6.1	Supply of Automatic Tensioning Device (ATD) Assembly along with counter weight assembly with SS wire Rope with Guide Tube etc	Supply of Automatic Tensioning Device (ATD) Assembly along with counter weight assembly with SS wire Rope with Guide Tube etc	1.62
E2.7 Insulators	E 2.7.1	Supply of all types of Insulators	Supply of all types of Insulators	3.04
E2.8 Motorised Isolator, Control Cable & PTFE	E 2.8.1	Supply of double pole motorised Isolators and single pole motorised Isolators with control cable with Jumpers, Section Insulators & PTFE.	Supply of double pole motorised Isolators and single pole motorised Isolators with control cable with Jumpers, Section Insulators & PTFE.	2.65
E2.9 Jumper, Anticreep wire, LS wire & Termination	E 2.9.1	Supply of Anticreep wire, along Feeder & Cross Feeder wires, Large span wire, Dropper assembly, All type Jumpers with clamps, All type Termination, NFW Suspension Clamp, 25 kV	Supply of Anticreep wire, along Feeder & Cross Feeder wires, Large span wire, Dropper assembly, All type Jumpers with clamps, All type Termination, NFW Suspension Clamp, 25 kV	5.88

Cost Centre		OHE Works		
Weightage of Cost Centre 'E2', (X)		55.87%		
Sub Cost Centre	Item of work		Milestone	Weightage (Y) (%)
	No	Description		
		power Cables, LT power cable with ACO panel, Insulating sleeve.	power Cables, LT power cable with ACO panel, Insulating sleeve.	
E2.10 Auxiliary Transformers	E 2.10.1	Supply of Auxiliary Transformers	Supply of Auxiliary Transformers	0.42
E2.11 ROCS works	E 2.11.1	Supply of ROCS Conductor rails, Support Bracket, including anchor Bolts, Cantilever assembly, Transition Element and Insulator etc	Supply of ROCS Conductor rails, Support Bracket, including anchor Bolts, Cantilever assembly, Transition Element and Insulator etc	6.23
E2.12 Balance Materials	E 2.12.1	Supply of Balance Materials i.e Retro Reflective Number Plate, Caution Board, Neutral Section Board, Engine stop Board, Warning Board, Sigma Board, Sectioning Diagram Board, Safety Screen Panel, Splices, D.O Fuse assembly, Nuts & Bolts, Protective Safety screen Panels etc to complete the entire works.	Supply of Balance Materials i.e Retro Reflective Number Plate, Caution Board, Neutral Section Board, Engine stop Board, Warning Board, Sigma Board, Sectioning Diagram Board, Safety Screen Panel, Splices, D.O Fuse assembly, Nuts & Bolts, Protective Safety screen Panels etc to complete the entire works.	0.32
E2.13 Foundation	E 2.13.1	Supply and Erection of Foundation, Grouting with Muffing including Nominal reinforcement with materials.	Supply and Erection of Foundation, Grouting with Muffing including Nominal reinforcement with materials.	12.66

Cost Centre		OHE Works		
Weightage of Cost Centre 'E2', (X)		55.87%		
Sub Cost Centre	Item of work		Milestone	Weightage (Y) (%)
	No	Description		
E2.14 Erection of Steel Structure	E 2.14.1	Erection of Galvanised Steel Structure (Mast/Portal/TTC), ROCS Support Bracket with Anchor Bolt, Cantilever, Conductor rail & Transition element and Insulators etc	Erection of Galvanised Steel Structure (Mast/Portal/TTC), ROCS Support Bracket with Anchor Bolt, Cantilever, Conductor rail & Transition element and Insulators etc	2.19
E2.15 Erection of Cantilever erection	E 2.15.1	Erection of OHE Cantilever assembly along with Insulator	Erection of OHE Cantilever assembly along with Insulator	0.66
E2.16 Erection of Balance Materials	E 2.16.1	Erection of Auxiliary Transformer, PTFE, Isolator, Section Insulator, Wiring, Droppering, ATD, .Cross Feeder, Along Feeders, Terminations, Guy rod, Jumpers, Cut in Insulators, insulating sleeves, Erection of protective screen, number plate, warning boards etc	Erection of Auxiliary Transformer, PTFE, Isolator, Section Insulator, Wiring, Droppering, ATD, .Cross Feeder, Along Feeders, Terminations, Guy rod, Jumpers, Cut in Insulators, insulating sleeves, Erection of protective screen, number plate, warning boards etc	2.33
E2.17 Earthing and Bonding	E 2.17.1	Supply and Erection of AEC, BEC (If Required), Earth electrode, GI Earth Strips, Lightning Protection, Safety screen, Earth Terminations etc.	Supply and Erection of AEC, BEC (If Required), Earth electrode, GI Earth Strips, Lightning Protection, Safety screen, Earth Terminations etc.	1.82
E2.18 Testing & Commissioning	E 2.18.1	Final Adjustment, SED Checking including Tower Wagon checking/Pantograph run, Commissioning/ Energisation of OHE system, Current collection test, completion of any other residual works of OHE system and electrical signage	Final Adjustment, SED Checking including Tower Wagon checking/Pantograph run, Commissioning/ Energisation of OHE system, Current collection test, completion of any other residual works of OHE system and electrical signage	1.96

Cost Centre		OHE Works		
Weightage of Cost Centre 'E2', (X)		55.87%		
Sub Cost Centre	Item of work		Milestone	Weightage (Y) (%)
	No	Description		
		and integrated testing as required	and integrated testing as required	
Total				100.00

Notes:

- 1 The value of each Milestones will be total lump sum accepted cost of Works for Schedule 'A' (LS) multiplied by X * Y. For example, the value of Milestone E2.1.1 will be equal to $LS * X * Y = LS \times 0.5587 \times 0.1563$
- 2 Adjustment to Contract Price pursuant to GCC 13.7 shall be applicable to the payments of Works executed under this Cost Centre.
- 3 *Deleted*
- 4 Payment will be made on pro rata *basis* as per weightage(s) given in the Cost Centre.

5.2.3 Stages of Payment i.e. Milestones of Cost Centre 'E3'- Traction Sub Station (TSS)

Cost Centre		Traction Sub Station (TSS)		
Weightage of Cost Centre 'E3', (X)		17%		
Sub Cost Centre	Items of Work		Milestone	Weightage (Y) (%)
	No	Description		
E 3.1 Ferrous Item	E 3.1.1	Supply of Steel structures and Small Parts Steel (SPS)	Supply of Steel structures and Small Parts Steel (SPS)	2.42
E 3.2 Traction Transformer	E 3.2.1	Supply of Scott connected Traction Transformers	Supply of Scott connected Traction Transformers	59.57
E 3.3 Auto Transformer	E 3.3.1	Supply of Auto Transformers and 25KV/240V Auxillary Transformers.	Supply of Auto Transformers and 25KV/240V Auxillary Transformers.	12.37
E 3.4 CB, CT, PT & Isolator Motorised	E 3.4.1	Supply of Three Pole Motorized Isolator, Double Pole Isolators including motorised, Switchgears and control gears, Circuit Breaker, interrupters, CT and PT with fittings and Fasteners.	Supply of Three Pole Isolator, Double Pole Isolators including motorised, Switchgears and control gears, Circuit Breaker, interrupters, CT and PT with fittings and Fasteners.	7.68
E 3.5 Control Relays Panels	E 3.5.1	Supply of Control and Relays Panels fully assembled	Supply of Control and Relays Panels fully assembled	1.38
E 3.6 Balance Materials	E 3.6.1	Supply of all other balance material including cables, AL/CU Busbars, Earthing material, Lightning Arresters, Battery set, Battery Chargers, Insulators, ACDB & DCDB, PFC equipment and power quality control devices, drop Jumpers, Conductor busbar, Termination Assemblies, D.O fuse assembly etc.	Supply of all other balance material including cables, AL/CU Busbars, Earthing material, Lightning Arresters, Battery set, Battery Chargers, Insulators, ACDB & DCDB, PFC equipment and power quality control devices, drop Jumpers, Conductor busbar, Termination Assemblies, D.O fuse assembly etc.	6.59
E 3.7 Foundation	E 3.7.1	(a) Completion of Earthwork, Fencing, and Foundation, Baffle wall, Cable Treach & cover, Brick work and Plastering - 3.89	(a) Completion of Earthwork, Fencing, and Foundation, Baffle wall, Cable Treach & cover, Brick work and Plastering - 3.89	3.89

Cost Centre		Traction Sub Station (TSS)		
Weightage of Cost Centre 'E3', (X)		17%		
Sub Cost Centre	Items of Work		Milestone	Weightage (Y) (%)
	No	Description		
E 3.8 Erection of Ferrous Item	E 3.8.1	Erection of Steel structures and SPS	Erection of Steel structures and SPS	0.10
E 3.9 Traction Transformer	E 3.9.1	Erection of Traction Transformers with accessories	Erection of Traction Transformers with accessories	0.10
E 3.10 Erection of Auto Transformer	E 3.10.1	Erection of Auto Transformers with accessories and 25KV/240V Auxillary Transformers.	Erection of Auto Transformers with accessories and 25KV/240V Auxillary Transformers.	0.20
E 3.11 Erection of CB, CT, PT & Isolator Motorised	E 3.11.1	Erection of Circuit Breaker, interrupters, isolators, CT, PT Control relay panel, Control & monitoring Equipment .	Erection of Circuit Breaker, interrupters, isolators, CT, PT Control relay panel, Control & monitoring Equipment .	0.41
E 3.12 Control Room Building	E 3.12.1	<p>a) Construction of control room building and its E&M works i.e Building electrification, Ventilation, Access control system and switch yard lighting including trenching, oil soak pit, water recharge pit & drainage works etc. and casting of Roads inside the TSS – 1.19% and</p> <p>b) Tower wagon shed work with inspection pit and Electricals works etc - 1.74 %</p>	<p>a) Construction of control room building and its E&M works i.e Building electrification, Ventilation, Access control system and switch yard lighting including trenching, oil soak pit, water recharge pit & drainage works etc. and casting of Roads inside the TSS – 1.19% and</p> <p>b) Tower wagon shed work with inspection pit and Electricals works etc - 1.74 %</p>	2.93

Cost Centre		Traction Sub Station (TSS)		
Weightage of Cost Centre 'E3', (X)		17%		
Sub Cost Centre	Items of Work		Milestone	Weightage (Y) (%)
	No	Description		
E 3.13 Balance Materials	E 3.13.1	Erection of all other balance indoor/outdoor equipment including Bus-bars, Earth mat, Earthing & Bonding system, Buried rail, Lighting Protection system, Fire extinguisher, Power Distribution boards, Cabling, ACSR conductors, 8 SWG GI wire, All type connectors & Splices, Insulators, Battery, Battery chargers, Signage & safety equipment's etc. as required for commissioning of TSSs	Erection of all other balance indoor/outdoor equipment including Bus-bars, Earth mat, Earthing & Bonding system, Buried rail, Lighting Protection system, Fire extinguisher, Power Distribution boards, Cabling, ACSR conductors, 8 SWG GI wire, All type connectors & Splices, Insulators, Battery, Battery chargers, Signage & safety equipment's etc. as required for commissioning of TSSs	0.40
E 3.14 Testing and Commissioning	E 3.14.1	Number plates, Other facilities, EIG Sanction and Testing and Commissioning of all equipment and Energisation.	Number plates, Other facilities, EIG Sanction and Testing and Commissioning of all equipment and Energisation.	1.96
Total				100.00

Notes:

- 1 The value of each Milestones will be total lump sum accepted cost of Works for Schedule 'A' (LS) multiplied by X * Y. For example, the value of Milestone E3.1.1 will be equal to $LS * X * Y = LS * 0.17 * 0.0242$
- 2 Adjustment to Contract Price pursuant to GCC 13.7 shall be applicable to the payments of Works executed under this Cost Centre.
- 3 *Deleted*
- 4 Payment will be made on pro rata *basis* as per weightage(s) given in this Cost Centre.

5.2.4 Stages of Payment i.e. Milestones of Cost Centre 'E4'- Sectioning Post (SP)

Cost Centre		Sectioning Post (SP)		
Weightage of Cost Centre 'E4', (X)		5.67%		
Sub Cost Centre	Item of work		Milestone	Weightage (Y) (%)
	No	Description		
E 4.1 Ferrous Item	E 4.1.1	Supply of Steel structures and Small Parts Steel (SPS)	Supply of Steel structures and Small Parts Steel (SPS)	1.65
E 4.2 Auto Transformer	E 4.2.1	Supply of Auto Transformers and 25KV/240V LT Auxillary Transformers	Supply of Auto Transformers and 25KV/240V LT Auxillary Transformers	55.12
E 4.3 CB, CT, PT & Isolator	E 4.3.1	Supply of Circuit Breaker, interrupters, CT, PT and isolators.	Supply of Circuit Breaker, interrupters, CT, PT and isolators.	10.63
E 4.4 Control Relays Panels	E 4.4.1	Supply of Control and Relays Panel with protective relays and Fault locator Panel.	Supply of Control and Relays Panel with protective relays and Fault locator Panel.	6.10
E 4.5 Balance Materials	E 4.5.1	Supply of all other balance material including cables, AL/CU Busbars, Earthing material, Buried rail, Lightning Arresters, Battery set, Battery Chargers, Insulators, ACDB & DCDB, drop Jumpers, Conductor busbar, Termination Assemblies, D.O fuse assembly, GI Earth Strip etc to complete the work.	Supply of all other balance material including cables, AL/CU Busbars, Earthing material, Buried rail, Lightning Arresters, Battery set, Battery Chargers, Insulators, ACDB & DCDB, drop Jumpers, Conductor busbar, Termination Assemblies, D.O fuse assembly, GI Earth Strip etc to complete the work.	17.00
E 4.6 Foundation	E 4.6.1	Completion of Earthwork, fencing and foundation work	Completion of Earthwork, fencing and foundation work	3.63
E 4.7 Control Room Building	E 4.7.1	Construction of control room building, inside road and its E&M works i.e Building electrification, Ventilation, Access control system and switch yard lighting including trenching, oil soak pit, water recharge pit & drainage works etc.	Construction of control room building, inside road and its E&M works i.e Building electrification, Ventilation, Access control system and switch yard lighting including trenching, oil soak pit, water recharge pit & drainage works etc.	1.72

Cost Centre		Sectioning Post (SP)		
Weightage of Cost Centre 'E4', (X)		5.67%		
Sub Cost Centre	Item of work		Milestone	Weightage (Y) (%)
	No	Description		
E 4.8 Erection of Ferrous Item	E 4.8.1	Erection of Steel structures and SPS	Erection of Steel structures and SPS	0.10
E 4.9 Erection of Auto Transformer	E 4.9.1	Erection of Auto Transformers and 25KV/240V Auxillary Transformers	Erection of Auto Transformers and 25KV/240V Auxillary Transformers	1.00
E 4.10 Erection of CB, CT, PT & Isolator	E 4.10.1	Erection of Switchgears and control gears, Circuit Breaker, interrupters, Isolators, CT, PT, Control Cables and Erection & Commissioning of Control & Relay panel and control cabling .	Erection of Switchgears and control gears, Circuit Breaker, interrupters, Isolators, CT, PT, Control Cables and Erection & Commissioning of Control & Relay panel and control cabling .	0.70
E 4.11 Balance Materials	E 4.11.1	Erection of all other balance indoor/outdoor equipment including Bus-bars, Earth mat/Earthing & Bonding system, Buried rail, Lighting Protection system, Insulators, Fire Extinguisher, Power Distribution boards, Cabling, Battery, Battery chargers, Signage, GI Earth Strip & safety equipment etc. as required for commissioning of Power Supply installation	Erection of all other balance indoor/outdoor equipment including Bus-bars, Earth mat/Earthing & Bonding system, Buried rail, Lighting Protection system, Insulators, Fire Extinguisher, Power Distribution boards, Cabling, Battery, Battery chargers, Signage, GI Earth Strip & safety equipment etc. as required for commissioning of Power Supply installation	0.40
E 4.12 Testing and Commissioning	E 4.12.1	Number plates, Other facilities, EIG Sanction and Testing and Commissioning of all equipment and Energisation.	Number plates, Other facilities, EIG Sanction and Testing and Commissioning of all equipment and Energisation.	1.95
Total				100.00

Notes:

- The value of each Milestones will be total lump sum accepted cost of Works for Schedule 'A' (LS) multiplied by X * Y. For example, the value of Milestone E2.1.1 will be equal to $LS * X * Y = LS * 0.0567 * 0.0165$

- 2 Adjustment to Contract Price pursuant to GCC 13.7 shall be applicable to the payments of Works executed under this Cost Centre.
- 3 Payment will be made on *pro rata basis* as per weightage(s) given in this Cost Centre.

5.2.5 Stages of Payment i.e. Milestones of Cost Centre 'E5'- Sub Sectioning Post (SSP)

Cost Centre		Sub Sectioning Post (SSP)		
Weightage of Cost Centre 'E5', (X)		5.33%		
Sub Cost Centre	Item of Work		Milestone	Weightage (Y) (%)
	No	Description		
E 5.1 Ferrous Item	E 5.1.1	Supply of Steel structures and Small Parts Steel (SPS)	Supply of Steel structures and Small Parts Steel (SPS)	2.90
E 5.2 Auto Transformer	E 5.2.1	Supply of Auto Transformers and 25KV/240V LT Auxiliary Transformers	Supply of Auto Transformers and 25KV/240V LT Auxiliary Transformers	49.00
E 5.3 Circuit Breaker, Current Transformer, Potential Transformer & Isolator	E 5.3.1	Supply of Switchgears and control gears, Circuit Breaker, interrupters, CT, PT and isolators.	Supply of Switchgears and control gears, Circuit Breaker, interrupters, CT, PT and isolators.	16.30
E 5.4 Control Relays Panels	E 5.4.1	Supply of Control and Relays Panels with protective relays and earth fault locator panel.	Supply of Control and Relays Panels with protective relays and earth fault locator panel.	11.00
E 5.5 Balance Materials	E 5.5.1	Supply of all other balance material including cables, AL/CU Busbars, Earthing material, Buried rail, Lightning Arresters, Battery set, Battery Chargers, Insulators, ACDB & DCDB, drop Jumpers, Conductor busbar, connectors and Splices, Termination assemblies, GI Earth Strip etc. to complete the work.	Supply of all other balance material including cables, AL/CU Busbars, Earthing material, Buried rail, Lightning Arresters, Battery set, Battery Chargers, Insulators, ACDB & DCDB, drop Jumpers, Conductor busbar, connectors and Splices, Termination assemblies, GI Earth Strip etc. to complete the work.	7.80
E 5.6 Foundation	E 5.6.1	Completion of Earthwork, fencing and foundation work	Completion of Earthwork, fencing and foundation work	5.10
E 5.7 Control Room Building	E 5.7.1	Construction of control room building, inside road and its E&M works i.e Building electrification, Ventilation, Access control system and switch yard lighting including trenching, oil soak pit, water	Construction of control room building, inside road and its E&M works i.e Building electrification, Ventilation, Access control system and switch yard lighting including trenching, oil soak pit, water	3.10

Cost Centre		Sub Sectioning Post (SSP)		
Weightage of Cost Centre 'E5', (X)		5.33%		
		recharge pit & drainage works etc.	recharge pit & drainage works etc.	
E 5.8 Erection of Ferrous Item	E 5.8.1	Erection of Steel structures and SPS	Erection of Steel structures and SPS	0.20
E 5.9 Erection of Auto Transformer	E 5.9.1	Erection of Auto Transformers and 25KV/240V Auxillary Transformers	Erection of Auto Transformers and 25KV/240V Auxillary Transformers	1.00
E 5.10 Erection of CB, CT, PT & Isolator	E 5.10.1	Erection of Switchgears and control gears, Circuit Breaker, interrupters, Isolators, CT, PT, Control Cables and Erection relay panel and control cabling.	Erection of Switchgears and control gears, Circuit Breaker, interrupters, Isolators, CT, PT, Control Cables and Erection relay panel and control cabling .	1.00
E 5.11 Balance Materials	E 5.11.1	Erection of all other balance indoor/outdoor equipment including Bus-bars, Earth mat/Earthing & Bonding system, Buried rail, Lighting Protection system, Insulators, Fire Extinguisher, Power Distribution boards, Cabling, Battery, Battery chargers, Signage, GI Earth Strip & safety equipment etc. as required for commissioning of Power Supply installation	Erection of all other balance indoor/outdoor equipment including Bus-bars, Earth mat/Earthing & Bonding system, Buried rail, Lighting Protection system, Insulators, Fire Extinguisher, Power Distribution boards, Cabling, Battery, Battery chargers, Signage, GI Earth Strip & safety equipment etc. as required for commissioning of Power Supply installation	0.60
E 5.12 Testing and Commissioning	E 5.12.1	Number plates, Other facilities, EIG Sanction and Testing and Commissioning of all equipment and Energisation.	Number plates, Other facilities, EIG Sanction and Testing and Commissioning of all equipment and Energisation.	2.00
Total				100.00

Notes:

- 1 The value of each Milestones will be total lump sum accepted cost of Works for Schedule 'A' (LS) multiplied by X * Y. For example, the value of Milestone E5.1.1 will be equal to $LS * X * Y = LS * 0.0533 * 0.0290$
- 2 Adjustment to Contract Price pursuant to GCC 13.7 shall be applicable to the payments of Works executed under this Cost Centre.
- 3 Payment will be made on pro rata *basis* as per weightage(s) given in this Cost Centre.

5.2.6 Stages of Payment i.e. Milestones of Cost Centre 'E6'- SCADA

Cost Centre		SCADA		
Weightage of Cost Centre 'E6', (X)		1.05%		
Sub Cost Centre	Item of work		Milestone	Weightage (Y) (%)
	No	Description		
E6.1 SCADA system Hardware	E 6.1.1	Supply and erection of SCADA system Hardware, Web server, UPS, Battery sets, GPS receiver, Earthing and Furniture along with associated equipment/materials at OCC.	Supply and erection of SCADA system Hardware, Web server, UPS, Battery sets, GPS receiver, Earthing and Furniture along with associated equipment/materials at OCC.	23.00
E6.2 SCADA software at remote control centre of boundary post of Northern Railway and DFFCIL	E 6.2.1	Installation of software of SCADA system and modifications/ Upgradation of SCADA software at remote control centre of boundary post of Northern Railway and DFFCIL	Installation of software of SCADA system and modifications/ Upgradation of SCADA software at remote control centre of boundary post of Northern Railway and DFFCIL	11.00
E6.3 RTU for TSS, SP & SSP	E 6.3.1	Supply and erection of Remote Terminal Units(RTUs) along with	Supply and erection of Remote Terminal Units(RTUs) along with	64.00
E 6.4 Testing & Commissioning	E 6.4.1	System Acceptance Testing and commissioning of SCADA system including Integrated Testing	System Acceptance Testing and commissioning of SCADA system including Integrated Testing	2.00
Total				100.00

Notes:

- 1 The value of each Milestones will be total lump sum accepted cost of Works for Schedule 'A' (LS) multiplied by X * Y. For example, the value of Milestone E6.1.1 will be equal to $LS * X * Y = LS * 0.0105 * 0.23$
- 2 Adjustment to Contract Price pursuant to GCC 13.7 shall be applicable to the payments of Works executed under this Cost Centre.
- 3 Payment will be made on pro rata completion of each Milestone as per weightage given in this Cost Centre.

5.2.7 Stages of Payment i.e. Milestones of Cost Centre 'E7'- Spares and Tools

Stages of Payment i.e. Milestones of Cost Centre 'E7'- Spares and Tools				
Cost Centre		Spares and Tools		
Weightage of Cost Centre 'E7', (X)		3.63%		
Sub Cost Centre	Item of Work		Milestone	Weightage (Y) (%)
	No.	Description		
E 7.1 Supply of Spares for OHE works	E 7.1.1	OHE & ROCS conductors, Jumpers, Droppers and OHE Fittings etc.	OHE & ROCS conductors, Jumpers, Droppers and OHE Fittings etc.	10.98
	E 7.1.2	Steel Structures	Steel Structures	6.16
	E 7.1.3	Cantilevers with Insulators	Cantilevers with Insulators	5.66
	E 7.1.4	Tower Wagons(90% payment on supply and rest 10% on successful commissioning of Tower Wagon	Tower Wagons(90% payment on supply and rest 10% on successful commissioning of Tower Wagon	38.26
	E 7.1.5	Balance items	Balance items	3.87
E7.2 Supply of Spares for Traction Power Installation:	E 7.2.1	Auto Transformers & Transformer spare parts	Auto Transformers & Transformer spare parts	15.80
	E 7.2.2	Interrupters	Interrupters	4.54
	E 7.2.3	Circuit Breakers	Circuit Breakers	4.54
	E 7.2.4	Isolators	Isolators	2.24
	E 7.2.5	Balance items	Balance items	2.24
E 7.3 Special Tools & instruments/ Equipment,	E 7.3.1	Supply of Special Tools & instruments/ Equipment, Drone etc	Supply of Special Tools & instruments/ Equipment, Drone etc	4.59
	E 7.3.2	Supply of Portable diagnostic modules for SCADA	Supply of Portable diagnostic modules for SCADA	1.12
Total				100.00

Notes:

- 1 The value of each Milestones will be total lump sum accepted cost of Works for Schedule 'A' (LS) multiplied by X * Y. For example, the value of Milestone E7.1.1 will be equal to $LS * X * Y = LS \times 0.0363 \times 0.1098$
- 2 Adjustment to Contract Price pursuant to GCC 13.7 shall NOT be applicable to the payments of Works executed under Sub Cost Centre E 7.3.
- 3 Payment will be made on pro rata *basis* as per weightage(s) given in this Cost Centre.

5.2.8 Stages of Payment i.e. Milestones of Cost Centre 'E8'- Annual Maintenance Contract (Comprehensive) for 3 Years

Cost Centre		Annual Maintenance Contract (Comprehensive) For 3 Years		
Weightage of Cost Centre 'E8', (X)		7.88%		
Sub Cost Centre	Item of Work		Milestone	Weightage (Y) (%)
	No	Description		
E 8.1 First Year Comprehensive Maintenance	E 8.1.1	Price of First year of Comprehensive Maintenance Contract	Price of First year of Comprehensive Maintenance Contract	31.00
E 8.2 Second Year Comprehensive Maintenance	E 8.1.2	Price of Second year of Comprehensive Maintenance Contract	Price of Second year of Comprehensive Maintenance Contract	33.00
E 8.3 Third Year Comprehensive Maintenance	E 8.1.3	Price of Third year of Comprehensive Maintenance Contract	Price of Third year of Comprehensive Maintenance Contract	36.00
Total				100.00

Notes:

- 1 The value of each Milestones will be total lump sum accepted cost of Works for Schedule 'A' (LS) multiplied by X * Y. For example, the value of Milestone E8.1.1 will be equal to $LS * X * Y = LS * 0.0788 * 0.31$
- 2 Adjustment to Contract Price pursuant to GCC 13.7 shall NOT be applicable to the payments of Works executed under this Cost Centre.
- 3 Payment will be made on completion of each Milestone as per weightage given in this Cost Centre.
- 4 The yearly amount shall be divided into 12 equal instalments and shall be paid on monthly basis after Certification by the Engineer.

5.3 Schedule 'B' OHE works for IR Connectivity and Feeder (Harsana Kalan IR SSP to New Harsana Kalan OHE)

Schedule 'B' is subdivided into eight Sub-Schedules as given below:

S. No.	Sub-Schedule	Description	No. of Items	Material (M) (INR)	Erection (E) (INR)	Total (INR)
1	2	3	4	5	6	7=5+6
1	B1	General	71	5,35,48,996.48	86,56,360.25	6,22,05,356.72
2	B2	Concrete	6	1,77,99,799.48	39,55,897.31	2,17,55,696.79
3	B3	Ferrous	27	5,63,53,342.11	40,28,799.76	6,03,82,141.87
4	B4	Non Ferrous	29	1,86,89,084.64	12,90,687.09	1,99,79,771.73
5	B5	Contact & Catenary wire	2	4,73,84,107.67	-	4,73,84,107.67
6	B6	Insulators	6	1,49,68,948.95	-	1,49,68,948.95
7	B7	SCADA at Harsana Kalan IR SSP	3	18,89,146.86	-	18,89,146.86
8	B8	Non- Schedule (NS) Items	16	1,36,54,013.00	-	1,36,54,013.00
Grand Total for IR & DFC Connectivity in INR						24,22,19,183.59

5.3.1 Sub-Schedule ‘B1’: General

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
1 (a)	Preparation of designs and drawings for overhead equipment, TSWR and as built drawings. All designs, LOP, CSD, Foundations, cable trench, gantry connections, FOB, ROB, SPS, Turnout, Cross Overs, Overlaps, PTFE, fencing, gate, earthing, control room building, gantry for interrupter, motorised Isolators etc including cross feeder and along feeders etc required for OHE works and SP at Sultanpur and Asaudah.	TKM	0.00	17,175.77	13.956	0.00	2,39,705.05	2,39,705.05
1(b)	Preparation of design and drawing for switching station Gantry, Locations, modifications in cross feeder, earthing, drop jumpers etc. Supply of as-built drawings in 6 hard copies and soft copies (cad and PDF) for DFC Prithla South SSP	LS	0.00	29,504.31	1	0.00	29,504.31	29,504.31
2	Supply (without insulator) and erection of mounting arrangements for span wire. All components including adjusters, terminal fitting and mast attachments required to attach a span wire or a head span wire or a cross span wire or a support span wire for supporting contact wire to the structure.	Each	6272.86	797.76	10	62,728.60	7,977.60	70,706.20

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
3	Marking/painting of temperature & 'Y'- Measurement of OHE mast at BWA locations including cost of paint	Each	0.00	113.97	36	0.00	4,102.92	4,102.92
4 (a)	Supply (without insulator) and erection of material for termination of Single conductor of Overhead equipment or terminating wire including terminating wire on structure along with mast anchor fittings, clevis assembly, adjuster, anchor double strap, ending clamp for catenary or contact wire and fittings including 9 ton assembly fitting.	Each	4727.68	749.97	8	37,821.44	5,999.76	43,821.20
4 (b)	Extra on erection under power block @100% on Item 4 (a)	Each	0.00	749.97	4	0.00	2,999.88	2,999.88
5	Supply without Insulator and erection of material for termination of all 25KV Feeder / return conductor including all materials required for termination along with mast anchor fitting, adjuster, strain clamp and fitting and 9-ton insulator assembly.	Each	5966.96	749.97	14	83,537.44	10,499.58	94,037.02
6 (a)	Supply (without insulator) and erection of anti-creep with Galvanised Steel wire including all materials for anticreep including adjuster, mast anchor fitting at its termination on either side, structure ending clamp, fittings etc	Each	5474.78	2420.86	10	54,747.80	24,208.60	78,956.40
6 (b)	Extra on erection under power block @100% on Item 6 (a)	Each	0.00	2420.86	5	0.00	12,104.30	12,104.30

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
7 (a)	Supply (without insulator) and erection of cut-in (9Tonne) Insulator including components required for cut-in insulators assembly, Terminal fittings for conductor etc.	Each	1349.09	520.17	418	5,63,919.62	2,17,431.06	7,81,350.68
7 (b)	Extra on erection under power block @100% on Item 7(a)	Each	0.00	520.17	218	0.00	1,13,397.06	1,13,397.06
8	Supply (without insulator) and erection of a suspension (9 Tonne) Insulator including 9 ton suspension insulator assembly for suspension of feeder wire etc including supply of all components, clamps, nuts bolts etc. including armour tape.	Each	1398.11	308.81	21	29,360.31	6,485.01	35,845.32
9	Supply (without insulator) and erection of 25 kV Post Insulator including supply of all components and fittings, (Out rigger) support jumpers including nuts bolts etc	Each	1009.85	238.96	32	32,315.20	7,646.72	39,961.92
10 (a)	Transfer of equipment from one mast or support to another including dismantling of erected bracket from old structure and consequent adjustment to OHE require such as respacing of dropper (including cost of dropper wire) levelling etc.	Each	1576.55	2167.18	166	2,61,707.30	3,59,751.88	6,21,459.18
10 (b)	Extra on erection under power block @100% on Item 10 (a)	Each	0.00	2167.18	166	0.00	3,59,751.88	3,59,751.88

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
11 (a)	Erection of an additional bracket assembly/ assemblies on a mast or support include dismantling of an existing bracket assembly and erection of multiple cross arm wherever required and erection of bracket assembly on multiple cantilever cross arm along with any consequential adjustment to traction overhead such as respacing of droppers, levelling including nut, bolts, washers etc.	Each	0.00	1924.55	170	0.00	3,27,173.50	3,27,173.50
11 (b)	Extra on erection under power block @100% on Item 11 (a)	Each	0.00	1924.55	170	0.00	3,27,173.50	3,27,173.50
12 (a)	Re-adjustment of head-span include readjustment of headspan to enable the additional equipment to be suspended form headspan.	Each	0.00	2124.91	100	0.00	2,12,491.00	2,12,491.00
12 (b)	Extra on erection under power block @100% on Item 12 (a)	Each	0.00	2124.91	100	0.00	2,12,491.00	2,12,491.00
13 (a)	Dismantling of overhead equipment (Catenary, Contact, Dropper, Cantilever, Jumpers, Connectors and 9 Ton Insulator) include dismantling of equipment along with termination, tensioning devices, guy rod assemblies, bracket assemblies, associated SPS etc.	Km	0.00	11437.03	2	0.00	22,874.06	22,874.06
13 (b)	Extra on erection under power block @100% on Item 13 (a)	Km	0.00	11437.03	2	0.00	22,874.06	22,874.06

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
14 (a)	Dismantling of Feeder/ Return Conductor including guy rods, terminations, suspension assemblies, super mast and associated SPS.	Km	0.00	4957.52	0.5	0.00	2,478.76	2,478.76
14 (b)	Extra on erection under power block @100% on Item 14 (a)	Km	0.00	4957.52	0.5	0.00	2,478.76	2,478.76
15 (a)	Splicing & extension of an anchored overhead equipment include splicing of terminated overhead equipment for extension and consequent adjustment of affected equipment. The extended overhead equipment shall be deemed as starting from the centre line of the structure preceding the old terminating structure and the extended overhead equipment including nuts, bolts and washers etc.	Each	0.00	2124.91	20	0.00	42,498.20	42,498.20
15 (b)	Extra on erection under power block @100% on Item 15 (a)	Each	0.00	2124.91	20	0.00	42,498.20	42,498.20
16 (a)	Dismantling of a Section Insulator Assembly include dismantling of contact wire, catenary wire, droppers and dismantling of section insulator and splicing of catenary/ contact wire and necessary adjustment to droppers (including dropper material).	Each	1313.79	2124.91	10	13,137.90	21,249.10	34,387.00

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
16 (b)	Extra on erection under power block @100% on Item 16 (a)	Each	0.00	2124.91	10	0.00	21,249.10	21,249.10
17	Slewing and putting back of OHE in original shape include temporary slewing or lowering of erected OHE and/ or on adjusted to ground for special work and restoration and readjustment of the equipment after completion of special works.	Span	0.00	1722.36	50	0.00	86,118.00	86,118.00
18	Dismantling of Guy Rod include dismantling of all fittings and SPS.	Each	0.00	694.09	50	0.00	34,704.50	34,704.50
19 (a)	Dismantling of Cantilever include dismantling of catenary/contact wire, anticreep wire (if any), fitting and SPS supporting the cantilever.	Each	0.00	687.03	110	0.00	75,573.30	75,573.30
19 (b)	Extra on Dismantling under power block @100% on Item 19 (a)	Each	0.00	687.03	110	0.00	75,573.30	75,573.30
20 (a)	Dismantling of Mast/TTC/Gantry include dismantling of foundation 150 mm below the ground level and cutting of mast/structure and finishing the ground by proper compaction and stacking of Mast/Gantry properly. (Dismantled Materials shall be handed over to IR/DFC in store.	MT	0.00	4587.13	20	0.00	91,742.60	91,742.60
20 (b)	Extra on Dismantling under power block @100% on Item 20 (a)	MT	0.00	4587.13	20	0.00	91,742.60	91,742.60

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
21 (a)	Dismantling of Portal include Dismantling of foundation 150 mm below the ground level and cutting of portal and finishing the ground by proper compaction and stacking of portal, boom properly. Materials shall be handed over to IR/DFC in store.	MT	0.00	6426.00	10	0.00	64,260.00	64,260.00
21 (b)	Extra on Dismantling under power block @100% on Item 21 (a)	MT	0.00	6426.00	10	0.00	64,260.00	64,260.00
22 (a)	Dismantling of Copper/ Aluminium Jumper include dismantling of all clamps, PG clamps, nut bolt etc.	Each	0.00	360.00	20	0.00	7,200.00	7,200.00
22 (b)	Extra on Dismantling under power block @100% on Item 22 (b)	Each	0.00	360.00	20	0.00	7,200.00	7,200.00
23 (a)	Shifting of ATD with BWA from one mast/ Support to another including nut, bolts, washers etc.	each	0.00	3091.30	20	0.00	61,826.00	61,826.00
23 (b)	Extra on Dismantling under power block @100% on Item 23 (a)	Each	0.00	3091.30	20	0.00	61,826.00	61,826.00
24 (a)	Dismantling of ATD with BWA include all fittings, attachment and SPS and anchoring of OHE at Structure.	Each	0.00	2049.51	20	0.00	40,990.20	40,990.20
24 (b)	Extra on Dismantling under power block @100% on Item 24 (a)	Each	0.00	2049.51	20	0.00	40,990.20	40,990.20

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
25 (a)	Adjustment on Bracket Assembly for lower/raising the height of contact and catenary wire where encumbrance is changed	Each	0.00	2093.82	73	0.00	1,52,848.86	1,52,848.86
25 (b)	Extra on Dismantling under power block @100% on Item 25 (a)	Each	0.00	2093.82	73	0.00	1,52,848.86	1,52,848.86
26	Adjustment on Bracket Assembly for lowering /raising the height of contact and catenary wire where encumbrance is not changed	Each	0.00	1914.77	73	0.00	1,39,778.21	1,39,778.21
27 (a)	Dismantling OHE Termination Assembly including all fittings and SPS etc.	Each	0.00	1149.54	23	0.00	26,439.42	26,439.42
27 (b)	Extra on Dismantling under power block @100% on Item 27 (b)	Each	0.00	1149.54	23	0.00	26,439.42	26,439.42
28 (a)	Dismantling of anchor Assembly include dismantling of anchor terminations and SPS.	Each	0.00	894.76	20	0.00	17,895.20	17,895.20
28 (b)	Extra on Dismantling under power block @100% on Item	Each	0.00	894.76	20	0.00	17,895.20	17,895.20
29	Loading, Leading, Transportation, Unloading and stacking of steel structure, conductor, cantilever assembly, ATD, etc form dismantling site to concerned Engineer in charge store	MT	0.00	3343.50	100	0.00	3,34,350.00	3,34,350.00

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
30	Dismantling of an Isolator including dismantling of connections to the overhead equipment and associated SPS	Each	0.00	1152.53	10	0.00	11,525.30	11,525.30
31	Dismantling of a Post/ Pedestal Insulator including dismantling of connection to the overhead equipment and associated SPS.	Each	0.00	374.98	40	0.00	14,999.20	14,999.20
32	Loading of all type of Steel Structures include BFB/ RSJ, B -series, special structure, N,O & R type) tailor/ truck over and above the requirement given by the contractor for the completion of work or actual qty utilised in the completion of work.	MT	0.00	207.71	200	0.00	41,542.00	41,542.00
33	Unloading of all type of Steel Structures include BFB/ RSJ, B -series, special structure, N,O & R type) tailor/ truck over and above the requirement given by the contractor for the completion of work or actual qty utilised in the completion of work.	MT	0.00	112.13	200	0.00	22,426.00	22,426.00

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
34	Unloading of all type of Copper & Aluminium conductors include for all type of copper conductors (contact wire, catenary wire, dropper, bridle wire, jumpers etc) and aluminium conductors (spider conductors etc) into tower wagon/ trailer/truck over above the requirement given by contractor for the completion of work or actual qty utilised in the completion of work.	MT	0.00	101.10	12	0.00	1,213.20	1,213.20
35	Loading of all type of Copper & Aluminium conductors include for all type of copper conductors (contact wire, catenary wire, dropper, bridle wire, jumpers etc) and aluminium conductors (spider conductors etc) into tower wagon/ trailer/truck over above the requirement given by contractor for the completion of work or actual qty utilised in the completion of work.	MT	0.00	101.10	12	0.00	1,213.20	1,213.20
36	Supply and erection of copper control cables include installation and connecting up of cables for control and indication from the equipment (interrupter, motorised isolators etc) to the terminal board and terminal connectors at both end. If required to the conduits may be provided where it is necessary	m	394.14	12.87	7900	31,13,706.00	1,01,673.00	32,15,379.00

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
37	Supply and erection of LT power cables copper (for motorised isolators, interrupter and other applications) with route markers	m	425.51	18.38	7500	31,91,325.00	1,37,850.00	33,29,175.00
38	Excavation of trench for laying LT power cables and control cables with brick protection (class designation not below 7.5) and back filling with sand and earth etc with route marker as per drawing.	m	224.15	0.00	19,500	43,70,925.00	0.00	43,70,925.00
39	Supply and laying GI/HDPE pipe under road/ground/ floor/Railway Tracks in already excavated trench as per site and as per drawing.	m	369.39	0.00	400	1,47,756.00	0.00	1,47,756.00
40	Provision of wooden key box with glass front in frame with hinges	Nos	2701.00	0.00	4	10,804.00	0.00	10,804.00
41	Supply and erection of electric shock treatment chart and first aid coloured calendar	Nos	58.00	0.00	14	812.00	0.00	812.00
42	Supply and erection of protective screen include fabrication of protective screen and angle, Tee, expanded metal (jali), GI sheet, paints etc.	sqm	7684.47	830.48	100	7,68,447.00	83,048.00	8,51,495.00
43 (a)	Supply and erection of Aerial Earth Wire 92 sqmm ASCR including mast fittings and terminations.	TKM	56,651.63	2832.58	1.2	67,981.96	3,399.10	71,381.05
43 (b)	Extra on erection under power block @100% on item-43 (a)	TKM	0.00	2832.58	1.2	0.00	3,399.10	3,399.10

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
44 (a)	Supply and erection of Negative feeder Wire 288 sqmm AAAC	TKM	1,85,554.32	19,167.50	1.2	2,22,665.18	23,001.00	2,45,666.18
44 (b)	Extra on erection under power block @100% on item-44 (a)	TKM	0.00	19,167.50	1.2	0.00	23,001.00	23,001.00
45	Supply and erection of termination assembly for NFW	Nos	9698.00	987.00	0.756	7,331.69	746.17	8,077.86
46	Supply of suspension clamp assembly for NFW	Nos	2980.00	0.00	4	11,920.00	0.00	11,920.00
47	Supply (without insulator) and erection of material for termination of all 25KV Feeder / return conductor including all materials required for termination along with mast anchor fitting, adjuster, strain clamp and fitting and 9-ton insulator assembly.	Nos	5,967.02	749.90	6	35,802.12	4499.40	40,301.52
48 (a)	Supply (without insulator) and erection of materials for termination of copper cross feeder with gantries include mast anchor fitting, clavis, 9 ton adjuster, feeder ending clamp, double clavis and other component as necessary along with 9 ton insulator assembly and termination of cross feeder at either end. fitting component required for termination of one cross feeder at both ends constitute one set.	Set	5,676.81	749.90	22	1,24,889.82	16,497.80	1,41,387.62
48 (b)	Extra on erection under power block @100% on item No.69	Set	0.00	749.90	12	0.00	8998.80	8,998.80

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
48 (c)	Extra on Dismantling under power block @100% on Item 69 (Dismantled materials shall be handed over to DFC in store).	set	0.00	749.90	12	0.00	8998.80	8,998.80
49	Supply & Erection of 25kV Vacuum type Interrupter include single pole outdoor type interrupter and components and erection of the same complete with supporting frame and terminal connectors and grouting on foundation block etc. Including enabled number plate.	Nos	3,40,198.50	3,516.09	10	34,01,985.00	35,160.90	34,37,145.90
50	Supply and Erection of 25kV Potential Transformers Type-I include complete fitting with accessories, terminal connectors and fixing boards including enabled number plates with fixing bolts and all SPS.	Nos	87,193.38	788.50	9	7,84,740.42	7096.50	7,91,836.92
51	Supply and Erection of 42KV Lightning Arrestors (station class) include all fittings, accessories, and terminal connectors along with enabled number plate and all SPS.	Nos	29,646.85	510.96	8	2,37,174.80	4087.68	2,41,262.48
52	Supply and Erection of 7.5 KV Lightning Arrestors include all fittings accessories and terminal connectors along with enabled number plate and all SPS.	Nos	1,382.43	266.51	0	0	0	0.00

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
53	Supply and Erection of Terminal Boards in control cubicles include wall mounted terminal boards with six numbers of two-way terminal blocks for connecting the cables form the outdoor equipment.	Nos	9,924.11	374.95	3	29,772.33	1124.85	30,897.18
54	Supply and Erection of an Iron clad 15A, 110 V.D.C Fuse Box complete with 2 fuse carriers and bases.	Nos	3,123.71	86.39	3	9371.13	259.17	9,630.30
55	Supply and erection of an Iron clad 230 V.A.C Fuse Box. The fuse box shall contain 4 fuse carriers and bases.	Nos	3,455.11	86.39	3	10,365.33	259.17	10,624.50
56	Supply and Erection of Lead Acid Batteries. (40 AH) include 110 V, 40 AH laid acid batteries complete with stands, accessories, and tool board with all connectors. This will also include supply of electrolyte, tool board with thermometer, hydrometer, and wrench.	Nos	83,759.84	5,633.47	2	1,67,519.68	11266.94	1,78,786.62
57	Supply and Erection of Battery chargers for 110 V, 40 AH laid acid batteries complete with connecting lead and plug for connection to 230V AC supply.	Nos	81,547.95	768.28	2	1,63,095.90	1536.56	1,64,632.46

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
58	Supply and Installation of cables (copper) for Heater supply from interrupter to 230 V AC fuse box and from fuse box to LT distribution board inside the control cubicle and include terminal connectors at both ends.	Metre	186.29	12.87	400	74,516.00	5148.00	79,664.00
59	Supply and Installation of cables (copper) for Catenary indication from potential transformer to terminal board in the control cubicle including terminal connectors at both ends with all fasteners on structural members and conduit etc.	Metre	268.64	12.87	400	1,07,456.00	5148.00	1,12,604.00
60	Supply and Installation of cables (copper) for L.T. Power supply, laying in trenches, and connecting LT Power supply cable between LT supply auxiliary transformer at switching station and LT distribution board inside the control cubicle along with suitable cable boxes and connectors at both ends.	Metre	425.52	18.38	95	40,424.40	1746.10	42,170.50
61	Supply and Installation of copper cables for 110V D.C. supply between 110V battery charger and battery, between battery and the D.C fuse box and between D.C fuse box and terminal board including terminal connectors.	Metre	268.64	18.38	150	40,296.00	2757.00	43,053.00

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
62	Supply, Erection, oil- filtration, testing and commissioning of L.T. supply auxiliary transformers (25 kVA).	Nos	1,83,561.81	8,403.34	62	1,13,80,832.22	5,21,007.08	1,19,01,839.30
63	Supply, Erection, oil- filtration, testing and commissioning of L.T. supply auxiliary transformers (10 kVA).	Nos	67,906.00	11,320.00	0	0.00	0.00	0.00
64	Supply and laying of 2 core 70 sqmm, 1.1 kV grade LT XLPE insulated armoured copper conductor cable, making good the damages and termination with copper crimping socket/plug. Provision of cable route markers, testing and commissioning etc. Laying includes excavation of trench, filling the trench with earth/sand with protective bricks etc as per drawing, from auxiliary transformer to Panel Board.	m	737.80	184.15	0	0.00	0.00	0.00
65	Supply and laying of 2 core 130 sqmm, 1.1 kV grade LT XLPE insulated armoured copper conductor cable, making good the damages and termination with copper crimping socket/plug. Provision of cable route markers, testing and commissioning etc. Laying includes excavation of trench, filling the trench with earth/sand with protective bricks etc as per drawing, from auxiliary transformer to Panel Board.	m	1,521.63	184.15	12000	1,82,59,560.00	22,09,800.00	2,04,69,360.00

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
66	Supply and erection of Iron clad 230 V.A.C Fuse Box and mounting near auxiliary transformer on mast. The fuse box shall contain 2 nos. 63 A double pole MCB (one being spare). The GI pipe of 75 mm dia pipe about 2-3 m long as per site condition and having round bend at one end for cable exit 300 mm below the ground level and upper end properly sealed, shall be provided along with necessary clamps etc.	Nos	4,955.11	270.54	60	2,97,306.60	16,232.40	3,13,539.00
67	Supply without Insulator & erection of 25 kV D.O. fuse switch completes with all mounting accessories and terminal connectors.	Nos	9,675.08	439.28	62	5,99,854.96	27,235.36	6,27,090.32

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
68	Supply and Erection of materials for internal and external lighting of Switching Station Building (SP/SSP). This includes fixing of GI conduit on wall and drawings of wire circuit with cast iron switch boxes concealed in wall with switches plug etc. provision of main board and distribution board and connections. provision of light fittings, exhaust fan, outdoor luminaires complete with tubes, bulb etc. Provision of earthing station and connection between earthing station to main board with 8 SWG GI wire. All material i.e., light fitting, exhaust fan switch sockets, sealing rose etc shall be ISI mark. Provision of 150-watt HPSV streetlight fitting complete in respect including lamp on wall of the building, complete testing of wiring and earthing etc.	Nos	25,752.11	6,034.52	3	77,256.33	18,103.56	95,359.89
69	Design and drawings for Modification in Harsana Kalan IR SSP and Feeders from Harsana Kalan IR SSP to New Harsana Kalan HORC OHE (Feeder Length Approximate 5 TKM)	Nos	33,147.30	0.00	0	0.00	0.00	0.00
70 (a)	Shifting and modification to terminalisation of aluminium cross feeder from SSP tower to gantries (slack feeder) including ending cone and fittings etc. (for DFC Prithla south SSP).	set	0.00	749.90	12	0.00	8998.80	8,998.80

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
70 (b)	Extra on Shifting under power block @100% on Item 91	set	0.00	749.90	12	0.00	8998.80	8,998.80
71	Supply, Erection, Testing in commissioning of control and distribution panel (Auto change over) for colour light signalling for 25 kVA AT supply in 25 kV AC traction system as per RDSO technical specification TI/SPS/PSI/CLS/0020(Amendment-4 or latest).	Nos	77,563.80	15,512.76	60	46,53,828.00	9,30,765.60	55,84,593.60
Total of Sub-Schedule 'B1': General						5,35,48,996.48	86,56,360.25	6,22,05,356.72

5.3.2 Sub-Schedule 'B2': Concrete

SUB-SCHEDULE 'B2': CONCRETE								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
1	Supply and Erection of concrete of foundation and Plinth in all type of soil using M-20 Grade concrete for Main Foundation and M -20 for Grouting and Muffing including Reinforcement along with excavation, dressing, and compaction of earth etc.	Cum.	9458.66	2102.90	1770	1,67,41,828.20	37,22,133.00	2,04,63,961.00
2	Supply of materials and construction of Super Structure of SP/SSP building (Control cubicles) include RCC work including reinforcement precast RCC slab, concrete flooring, cable trench, brick masonry, plastering work, doors, window grills, rolling shutter, water pipe line ventilators and painting, white washing and colour washing, acid proof or painting of floor and wall in battery room, spreading of stone metal, provision of RCC pipe etc. The window glasses shall be minimum 5 mm thick toughened glass, plastering work 1: 4 cement sand ratio, minimum concrete grade M-20 and minimum brick compressive strength class 10.	Nos	2,15,951.91	50639.47	3	6,47,855.73	1,51,918.41	7,99,774.00
3	Brick work in foundation plinth, retaining walls and drainage. Brick class designation minimum 10.	Cum.	3191.80	748.46	100	3,19,180.00	74,846.00	3,94,026.00

SUB-SCHEDULE 'B2': CONCRETE								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
4	Plastering of retaining wall with 1:4 cement & sand mortar. (Erection include material)	Sqm	95.52	22.40	300	28,656.00	6,720.00	35,376.00
5	Supply & Spreading of Ballast/Gravel in the Switch Yard of 20 mm nominal size (single sized) and having minimum 150 mm layer depth on the finished ground	Sqm	1144.19	6.22	45	51,488.55	279.90	51,768.00
6	Earth work in excavation and dumping at site of SSP/SP upto required level include all material and labour, necessary tools & plants including transportation, watering, ramming, levelling, and compaction to more than 95%.	cum	107.91		100	10,791.00	0.00	10,791.00
Total of Sub-Schedule 'B2': Concrete						1,77,99,799.48	39,55,897.31	2,17,55,696.79

5.3.3 Sub-Schedule 'B3': Ferrous

SUB-SCHEDULE 'B3': FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
1	Supply and erection of fabricated and galvanised structures ((O, N & R type portals and Gantry portal (600x600mm) with all necessary components. Portal for High rise OHE include Erection, Alignment and setting before grouting, wherever required of portals assembly of boom components and erection of the same including galvanised bolts, nuts, washers etc.	MT	1,40,052.71	8561.82	120	1,68,06,325.20	10,27,418.40	1,78,33,743.60
2	Extra on erection under power block @100% on Item 1 erection of steel	MT	0.00	8561.82	65	0.00	5,56,518.30	5,56,518.30
3	Supply and erection of Structure steel (traction masts) fabricated and galvanised of all Type: B-Series Mast. B- series Traction mast for conventional and high-rise OHE include Erection, Alignment and setting before grouting of individual traction mast	MT	1,18,127.05	2503.84	177.12	2,09,22,663.10	4,43,480.14	2,13,66,143.24
4	Extra on erection under power block @100% on Item 3 erection of steel	MT	0.00	2503.84	92	0.00	2,30,353.28	2,30,353.28
5	Supply only of fabricated steel other than masts (SPS)	MT	1,72,307.95	0.00	16.96	29,22,342.83	0.00	29,22,342.83

SUB-SCHEDULE 'B3': FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
6	Supply and erection of a Guy Rod Assembly include both conventional and High rise OHE, of various lengths for traction masts, feeder line towers or supports complete with mast/ portal guy rod fittings, guy rod with adjustments and parts be grouted in the anchor block and erection of dwarf or stub mast with anchor plates drilled and welded in position, where required, for anchorage, SPS works, complete with bolts and nuts etc.	Each	10626.05	1142.06	72	7,65,075.60	82,228.32	8,47,303.92
7	Supply and erection of 25 kV Caution Boards, Warning Board, Number Plate, PTFE Board, Sigma Board etc. including all type boards, SPS items, nuts, bolts etc	Each	340.68	101.41	168	57,234.24	17,036.88	74,271.12
8	Supply without insulator and erection of Single bracket assembly on the traction mast or support on drop arm and shall include those on high/low level platform, in the vicinity on the turnouts, over bridges or and at locations with reduced encumbrance or terminating wires. All components including galvanised steel tubes, dropper wires, bolts and nut etc.	Each	14911.84	1035.82	319	47,56,876.96	3,30,426.58	50,87,303.54
9	Extra on erection under power block @100% on item 8	Each	0.00	1035.82	181	0.00	1,87,483.42	1,87,483.42

SUB-SCHEDULE 'B3': FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
10	Supply and erection of Regulating Equipment ATD (3-Pulley type) with counter weight assembly for conventional/Regulated OHE 2400 Kgf Tension include counter weight assembly (for both conventional and high rise OHE) including 9 Ton adjuster with double strap assembly normal/ anti-theft guide tube assembly and regulating equipment and stainless steel wire rope(various length as required) required for the regulating equipment and SPS works including nuts, bolts, washers etc.	Each	83702.91	4259.18	33	27,62,196.03	1,40,552.94	29,02,748.97
11	Extra on erection under power block @100% on item 8	Each	0.00	4259.18	18	0.00	76,665.24	76,665.24
12	Supply without Insulator and erection of materials for termination of Double conductor include all materials necessary for the termination of two overhead equipment conductors on a traction mast or structure, including appropriate mast anchoring, clavis assembly, two adjusters, ending clamps for catenary and contact wires, anchor double strap assembly, equalising/ compensating plate and fittings including 9- ton insulator (cost of insulator will be paid in section-5) assembly and terminating wire if any.	Each	10883.51	1132.40	49	5,33,291.99	55,487.60	5,88,779.59

SUB-SCHEDULE 'B3': FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
13	Extra on erection under power block @100% on item 12	Each	0.00	1132.40	25	0.00	28,310.00	28,310.00
14	Supply and erection of a structure bond include GI flat (40x 6 mm) required to provide a structure bond connecting a traction mast or structures to the nearest non-track circuited rail, or earth electrode, including shaping and drilling of the bond and erection of all fasteners (GI) at both ends. provision of heat shrinkable PVC tube for structure bond under track circuit rail.	Each	1373.12	316.30	307	4,21,547.84	97,104.10	5,18,651.94
15	Supply and erection of a longitudinal bond including GI flat (40x 6 mm), GI fasteners etc. required to provide longitudinal bond connecting two rails at the rail joint at the locations including shaping and drilling of the bond and erection of all fasteners at both ends.	Each	774.98	282.50	60	46,498.80	16,950.00	63,448.80
16	Supply & erection of a transverse and special bond including GI flats (50x 6 mm), fasteners etc. required to provide transverse bond connecting rails of the same/ adjacent tracks at locations. Including GI flat to provide special bonds at level crossing, FOB, ROB, bridge/protective screen etc. including shaping and drilling of the bond and erection of all fasteners at both ends	Each	1765.81	338.03	31	54,740.11	10,478.93	65,219.04

SUB-SCHEDULE 'B3': FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
17	Supply & erection of a steel Rod Copper clad 3 m Long, 19.3 mm dia earth electrode include embedded into the ground by driving or otherwise complete with protective concrete box and lugs suitable for directly connecting to GI flat.	Each	3097.31	1202.42	343	10,62,377.33	4,12,430.06	14,74,807.39
18	Supply and erection of earth bus for PTFE, Auxiliary Transformer etc include GI flats (50 x 6 mm) for providing earth bus. The earth bus buried at a depth of 300 mm below ground level. It shall be include connecting the earth bus to earth electrode and to various floor or wall mounted equipment or structure to be earthed and also connections to non-track circuited rail, wherever required. The connection of earth strip to each strip to each other shall be made either by riveting or by welding. The connection of earth strip to various equipment, structures, fencing shall be made with GI bolts, nuts, spring washer, locknuts etc.	Metre	327.68	84.51	21	6,881.28	1,774.71	8,655.99
19	Supply and erection of galvanised traction masts, main masts of switching stations fabricated in various lengths.	MT	1,10,502.09	2,503.84	10	11,05,020.90	25,038.40	11,30,059.30

SUB-SCHEDULE 'B3': FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
20	Supply & erection of a single earth electrode copper clad steel rod 19.3 mm dia and minimum 3 mtr length including excavation, back filling and compaction of earth with all connectors	Nos	3,097.31	1,202.42	128	3,96,455.68	1,53,909.80	5,50,365.44
21	Supply and erection of earth bus for include GI flats (50 x 6 mm) for providing earth bus. The earth bus either buried at a depth of 300 mm below ground level. It shall be include connecting the earth bus to earth electrode and to various floor or wall mounted equipment or structure to be earthed and connections to non-track circuited rail, wherever required. The connection of earth strip to each strip to each other shall be made either by riveting or by welding. The connection of earth strip to various equipment, structures, fencing shall be made with GI bolts, nuts, spring washer, locknuts. etc.	Metre	327.68	84.51	500	1,63,840.00	42,255.00	2,06,095.00
22	Supply and erection of 8 SWG G.I. wire for earthing	Metre	28.61	21.73	100	2861.00	2173.00	5,034.00
23	Supply and erection of fencing panels at switching stations include GI fencing panels as per drawing with height of 2.4 mtr with all GI fasteners etc	Metre	5,976.18	94.17	400	23,90,472.00	37,668.00	24,28,140.00
24	Supply and erection of fencing GI uprights and embedded in foundation as per drawing	MT	1,65,270.73	4,512.70	6	9,91,624.38	27,076.20	10,18,700.58

SUB-SCHEDULE 'B3': FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
25	Supply and erection of anticlimbing device for Switching stations include galvanised steel fixtures mounted on fencing panels and GI barbed wire as per drawing	Metre	397.89	9.66	100	39,789.00	966.00	40,755.00
26	Supply and erection of anticlimbing device for L.T. Supply Transformer Stations. Include galvanised steel fixtures mounted on fencing panels and GI barbed wire.	Nos	1,651.38	357.35	64	1,05,688.32	22,870.40	1,28,558.72
27	Supply and erection of anti-monkey menace. Include hot dipped galvanised wire with GI angle 16 x16x8 mm with all GI bolts nuts barbed wire etc.	Nos	6,589.92	357.35	6	39,539.52	2144.10	41,683.62
Total of Sub-Schedule 'B3': Ferrous						5,63,53,342.11	40,28,799.76	6,03,82,141.87

5.3.4 Sub-Schedule 'B4': Non-Ferrous

SUB-SCHEDULE 'B4': NON-FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
1 (a)	Supply and erection of large span wire (150 sqmm).150 sqmm Jumper specification shall DIN 43138 or Latest RDSO specification.	Metre	1147.65	51.25	2200	25,24,830.00	1,12,750.00	26,37,580.00
1 (b)	Extra on erection under power block @100% on item 1 (a)	Metre	0.00	51.25	700	0.00	35,875.00	35,875.00
2 (a)	Erection of Contact wire, Catenary wire, Large Span wire and Supply and erection of Droppers, Jumpers, PG Clamps, Splices, parallel clamp, dropper clip with Nut Bolts, ending clamps, anchor, large span wire clamp, 9 ton adjuster, anchor double strap assembly, compensating/ equalising plate etc.	KM	1,07,747.91	30100.63	14	15,08,470.74	4,21,408.82	19,29,879.56
2 (b)	Extra on erection under power block @100% on item 2 (a)	KM	0.00	30100.63	7	0.00	2,10,704.41	2,10,704.41

SUB-SCHEDULE 'B4': NON-FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
3	Supply and Erection of Copper 25KV Feeder/ Return conductor (150 sqmm) for cross feeder/along feeder including erection of suspension assembly, termination and SPS complete with nut bolt etc. 150 sqmm Jumper specification shall DIN 43138 or Latest RDSO specification.	KM	2,02,434.34	5512.10	5.24	10,60,755.94	28,883.40	10,89,639.35
4 (a)	Supply and Erection of 25KV copper 160 sqmm cross feeder (HDBC) conductor. PG clamps shall be provided in 2x160 sqmm feeder at an interval not more than 5 meters (2 Runs of 160 sqmm wire shall laid for each cross feeder) (for DFC Prithla south SSP).160 sqmm Jumper specification shall DIN 43138 or Latest RDSO specification.	KM	9,49,190.00	18,000.00	1.2	11,39,028.00	21,600.00	11,60,628.00
4 (b)	Extra on erection under power block @100% on item 4 (a)		0.00	3526.32	1.2	0.00	4,231.59	4,231.59
4 (c)	Extra on Dismantling under power block @100% on Item 4 (c). (Dismantled materials shall be handed over to DFC in store).		0.00	3526.32	1.2	0.00	4,231.59	4,231.59

SUB-SCHEDULE 'B4': NON-FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
5 (a)	Supply and erection of light weight section insulator assembly	Each	1,34,226.00	3130.06	20	26,84,520.00	62,601.20	27,47,121.20
5 (b)	Extra on erection under power block @100% on item 6	Each	0.00	3130.06	12	0.00	37,560.72	37,560.72
6	Supply & Erection of Short Neutral section assembly (PTFE)	Each	6,07,005.76	4839.79	4	24,28,023.04	19,359.16	24,47,382.20
7 (a)	Supply without Insulator and erection of 25 KV single pole motorised isolator without earth contact assembly along with copper busbar	Each	1,17,602.19	2898.53	13	15,28,828.47	37,680.89	15,66,509.36
7 (b)	Extra on erection under power block @100% on item 7 (a)	Each	0.00	2898.53	6	0.00	17,391.18	17,391.18
8(a)	Supply & erection of large copper jumpers including drop jumper for cross feeder copper wire 150/160 sqmm include all clamps and GI nut bolts etc. (2 nos 160 sqmm copper drop jumpers shall come from cross feeder and one no. each shall be connected to catenary and contact wire).160 sqmm Jumper specification shall DIN 43138 or Latest RDSO specification.	Each	5779.49	525.39	62	3,58,328.38	32,574.18	3,90,902.56
8 (b)	Extra on erection under power block @100% on item 8 (a)	Each	0.00	525.40	33	0.00	17,338.20	17,338.20

SUB-SCHEDULE 'B4': NON-FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
9 (a)	Supply & erection of large copper drop jumpers 160 sq.mm between cross feeder and OHE including all clamps and GI bolts etc.(2 nos 160 sqmm copper drop jumpers shall come from cross feeder and one no. each shall be connected to catenary and contact wire).160 sqmm Jumper specification shall DIN 43138 or Latest RDSO specification.	Each	11,063.53	525.39	12	1,32,762.42	6,304.64	1,39,067.05
9 (b)	Extra on erection under power block @100% on item 17		0.00	525.39	12	0.00	6,304.64	6,304.64
9 (c)	Extra on Dismantling under power block @100% on Item 9 (a) (Dismantled materials shall be handed over to DFC office).		0.00	525.39	12	0.00	6,304.64	6,304.64
10	Supply of Earth wire include 19/2.5 mm galvanised steel stranded wire with termination, clamps, adjuster etc. It shall also include connecting by means suitable terminal spades, the end of earth screen wire to the main members of the column of portals, Gantries across which these wires are strung or to 50/6 mm G.I flat earth leads.	KM	99,575.72	2,689.25	0.5	49,787.86	1344.63	51,132.49

SUB-SCHEDULE 'B4': NON-FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
11	Supply without Insulator and erection of a 25 KV single pole isolator without earth contact assembly. (1600 Amp) for switching station.	Nos	41,717.05	2,898.51	10	4,17,170.50	28985.10	4,46,155.60
12	Supply without Insulators & erection of 25kV Double Pole Isolator.	Nos	68,029.85	3,201.28	10	6,80,298.50	32012.80	7,12,311.30
13	Supply & erection of large copper jumpers including for cross feeder copper wire 150 sqmm include all clamps and GI nut bolts etc.150 sqmm Jumper specification shall DIN 43138 or Latest RDSO specification.	Nos	5,779.18	525.38	50	2,88,959.00	26269.00	3,15,228.00
14	Supply & erection of small copper jumpers of 50 sqmm copper include supply of parallel clamp bimetallic strips wherever required and bolted type connector wherever required	Nos	677.46	525.38	72	48,777.12	37827.36	86,604.48
15	Supply of materials and erection of large copper jumper and drop jumper 160 Sq. mm between Aluminium bus and cross feeders	Nos	7,267.76	525.38	12	87,213.12	6304.56	93,517.68
16	Supply and erection of copper strips for equipment earthing.	Metre	624.47	71.24	45	28,101.15	3205.80	31,306.95

SUB-SCHEDULE 'B4': NON-FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
17	Supply & erection of: Aluminium bus-bars 36mm x 28mm.include bending shaping and clamping to insulators, connectors or terminals etc.	Metre	449.40	69.05	400	1,79,760.00	27620.00	2,07,380.00
18	Supply & erection of Solid copper busbars 18mm. Include bending shaping etc.	Metre	2,025.50	97.96	80	1,62,040.00	7836.80	1,69,876.80
19	Supply and erection of Aluminium bus-bar connectors: - Bus terminal (6480) including nut bolts etc at junctions and terminations	Nos	3,090.17	42.36	80	2,47,213.60	3388.80	2,50,602.40
20	Supply and erection of Aluminium bus-bar connectors: - Bus splice (6490) including nut bolts etc at junctions and terminations	Nos	3,414.97	42.35	80	2,73,197.60	3388.00	2,76,585.60
21	Supply and erection of Aluminium bus-bar connectors: - Bus tee connector (6500) including nut bolts etc at junctions and terminations	Nos	3,444.93	37.85	80	2,75,594.40	3028.00	2,78,622.40
22	Supply and erection of Aluminium bus-bar connectors: - Terminal connector 36/20 (6530) including nut bolts etc at junctions and terminations	Nos	3,108.50	37.85	80	2,48,680.00	3028.00	2,51,708.00

SUB-SCHEDULE 'B4': NON-FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
23	Supply and erection of Aluminium bus-bar connectors: - Tap connector (6520) including nut bolts etc at junctions and terminations	Nos	3,108.50	42.30	80	2,48,680.00	3384.00	2,52,064.00
24	Supply and erection of Aluminium bus-bar connectors: - Flexible bus splice (6550) including nut bolts etc at junctions and terminations	Nos	9,042.07	42.30	80	7,23,365.60	3384.00	7,26,749.60
25	Supply and erection of Aluminium bus-bar connectors: - Terminal connector Bolted Type (6830-1) including nut bolts etc at junctions and terminations	Nos	2,458.69	37.85	80	1,96,695.20	3028.00	1,99,723.20
26	Supply & erection of solid copper bus-bar connectors: Bus terminal (6310) including nut bolts etc at junctions and terminations	Nos	2,046.22	42.35	80	1,63,697.60	3388.00	1,67,085.60
27	Supply & erection of solid copper bus-bar connectors: Bus splice (6320) including nut bolts etc at junctions and terminations	Nos	2,258.21	42.35	80	1,80,656.80	3388.00	1,84,044.80
28	Supply & erection of solid copper bus-bar connectors: Bus tee joint (6330) including nut bolts etc at junctions and terminations	Nos	6138.66	42.34	80	4,94,480.00	3387.20	4,94,480.00

SUB-SCHEDULE 'B4': NON-FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
29	Supply & erection of solid copper bus-bar connectors: Bus terminating tee (6351) including nut bolts etc at junctions and terminations	Nos	4156.96	42.31	80	3,35,941.60	3384.80	3,35,941.60
Total of Sub-Schedule 'B4": Non-Ferrous						1,86,89,084.64	12,90,687.09	1,99,79,771.73

5.3.5 Sub-Schedule 'B5': Catenary and Contact Wire

SUB-SCHEDULE 'B5' CATENARY AND CONTACT WIRE								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
1	Supply 150 sqmm Hard Drawn Grooved Copper Contact Wire	TKM	11,30,172.62	0.00	23.476	2,65,31,932.43	0.00	2,65,31,932.43
2	Supply 120 sqmm, Cadmium copper catenary wire	TKM	9,70,952.47	0.00	21.476	2,08,52,175.25	0.00	2,08,52,175.25
Total of Sub-Schedule 'B5' : Catenary and Contact Wire						4,73,84,107.67	0	4,73,84,107.67

5.3.6 Sub-Schedule 'B6': Insulators

SUB-SCHEDULE 'B6' : INSULATORS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
1	Stay Arm Porcelain Insulators	Each	3341.31	0.00	370	12,36,284.70	0.00	12,36,284.70
2	Bracket Porcelain Insulators	Each	2875.71	0.00	370	10,64,012.70	0.00	10,64,012.70
3	9-Ton Porcelain Insulators	Each	4217.35	0.00	667	28,12,972.45	0.00	28,12,972.45
4	Supply of Post & Operating rod insulators	Set	44,233.90	0.00	207	91,56,417.30	0.00	91,56,417.30
5	Supply of 25 kV Post Insulator	Nos	8483.25	0.00	72	6,10,794.00	0.0	6,10,794.00
6	Supply of Post & Operating rod insulators for single pole Isolator	Set	22,116.95	0.00	4	88,467.80	0.0	88,467.80
Total of Sub-Schedule 'B6': Insulators						1,49,68,948.95	0.00	1,49,68,948.95

5.3.7 Sub-Schedule 'B7': SCADA at Harsana Kalan IR SSP

SUB-SCHEDULE 'B7' SCDA AT HARSANA KALAN IR SSP					
Item No.	Description	Unit	Qty.	Unit Rate of Supply & Erection in INR	Total Amount in INR
1	2	3	4	5	6 = 4x5
1	Design and drawings of all work of supply, erection, testing and commissioning of SCADA for the remote-control centre and the controlled station include supply of requisite number of copies of designs, drawings, operating, maintenance and troubleshooting manuals, technical booklets, and completion drawings.	Lumpsum	1	1,97,332.55	1,97,333.55
2	Supply, erection, testing and commissioning of Remote station equipment (RTU) at remote station for Sub-sectioning Post (SSP) including power supply units, separate earthing, interconnecting cables, wiring etc. and all materials necessary for proper functioning of RTU including testing of materials and equipment at manufacturer's works. This will also include necessary transducers, summation CT, PT, supply change over arrangement, digital analogue modules, limit settings, CPU cards, surge arrester, relays, and contactors etc.	Nos	1	9,08,444.86	9,08,445.86
3	Modification/upgradation, testing and commissioning in existing standard SCADA software at RCC equipment for configuration, integration/hooks up of additional RTU with master station equipment/RCC.	Nos	1	7,83,369.45	7,83,369.45
Total of Sub-Schedule 'B7' : SCADA at Harsana Kalan IR SSP					18,89,146.86

5.3.8 Sub-Schedule 'B8': Non-Schedule (NS) Items

SUB-SCHEDULE 'B8' NON-SCHEDULE (NS) ITEMS					
Item No.	Description	Unit	Qty.	Unit Rate of Supply & Erection in INR	Total Amount in INR
1	2	3	4	5	6 = 4x5
1	Supply and erection of OHE caution board with supply of fixing material (Clamp, back flat strip & fastener) for "caution clearance to OHE nearby rectified" Board Size 400mmx270mmx2mm	Nos.	60	758.27	45,496.20
2	Fabrication, developing and supply of sectioning diagram, schematic and TSWR board developing the sectioning diagram, schematic diagram & TSWR diagram with computerised digital printing on adhesive vinyl of adequate size as required.	Square foot	500	548.39	2,74,192.50
3	Setting up of earthing Station with buried rail at Switching post include supply of 75x8 mm GI flat for connection between buried rail and earth electrode and for connection between buried rail and running rail including nuts, bolts, copper rivets, spring washers, drilling of holes in flat /rail along with excavation and compaction of buried rail pit.	Job	3	65,313.00	1,95,939.00
4	Supply & Erection of Safety item with supply of fixing material (Plastic/wooden/gritty & Screw) for supply & erection of electric shock treatment chart (Glass framed) size 22"x28" complete with aluminium angle beading 1"x1" all around	Nos.	12	736.02	8,832.24
5	Provision of First Aid box and stretcher with wooden box and hanging arrangement etc.	Nos.	4	11,869.00	47,476.00
6	Provision of Wooden key box with glass front in frame with hinges and locking arrangement 18x24x6 inch.	Nos.	3	2,701.00	8,103.00
7	Supply of hand Gloves (Tested for 25 kV AC)	Nos.	6	1,155.00	6,930.00

SUB-SCHEDULE 'B8' NON-SCHEDULE (NS) ITEMS					
Item No.	Description	Unit	Qty.	Unit Rate of Supply & Erection in INR	Total Amount in INR
1	2	3	4	5	6 = 4x5
8	Provision of Portable firefighting Dry Chemical powder 5 Kg ISI mark	Nos.	3	3,270.00	9,810.00
9	Provision of Portable firefighting- CO2 fire extinguisher 10 Kg	Nos.	3	14,527.00	43,581.00
10	Provision of Portable firefighting- Fire bucket 10 Litres	Nos.	8	320.00	2,560.00
11	Provision of Portable firefighting- Fire bucket Stand	Nos.	4	2,139.00	8,556.00
12	Supply & Erection of Electric Shock treatment chart & its first aid coloured calendar in Hindi & English Size-550mm x 900mm with plastic at top & bottom	Nos.	6	58.00	348.00
13	Supply of AC and DC distribution board.	Nos.	3	41,787.07	1,25,361.21
14	Erection of AC and DC distribution board.	Nos.	3	886.83	2,660.49
15	(1) Hiring of AC vehicles Innova Crysta on monthly basis for the use of GC/HRIDC officials at Manesar/Gurugram for 2500 km per month. The rates are inclusive of all duties, GST, royalties, cost of maintenance, major/minor repairs, cost of lubricants, fuel, drivers, and other taxes etc for the complete job. Toll tax and parking charges shall be paid extra on certification of official using vehicle. Vehicles shall not be more than one year old.	vehicle month	96	69,345.00	66,57,120.00
	(2) Extra charge beyond 2500 km per month per vehicle (96x500=48000)	km	48000	13.09	6,28,320.00

SUB-SCHEDULE 'B8' NON-SCHEDULE (NS) ITEMS					
Item No.	Description	Unit	Qty.	Unit Rate of Supply & Erection in INR	Total Amount in INR
1	2	3	4	5	6 = 4x5
16	(1) Hiring of AC vehicles Bolero / Ertiga (SUV) on monthly basis for the use of GC/HRIDC officials at Manesar/Gurugram for 2500 km per month. The rates are inclusive of all duties, GST, royalties, cost of maintenance, major/minor repairs, cost of lubricants, fuel, drivers, and other taxes etc for the complete job. Toll tax and parking charges shall be paid extra on certification of official using vehicle. Vehicles shall not be more than one year old.	vehicle month	96	51,670.91	49,60,407.36
	(2) Extra charge beyond 2500 km per month per vehicle (96x500=48000)	km	48000	13.09	6,28,320.00
Sub-Schedule 'B8': Non-Schedule (NS) Items:					1,36,54,013.00
Grand Total of Schedule 'B': (B1+ B2+B3+B4+B5+B6+B7+B8)					24,22,19,183.59

Total Estimated amount for Schedule 'B': INR 24,22,19,183.59

Price Schedule

(Please refer Price Schedule uploaded on eProcurement portal)

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BoQ

Tender Inviting Authority: Haryana Rail Infrastructure Development Corporation Limited

Name of Work: Contract Package SYS-1: Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification, Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km 125.98 to Km 125.98 including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC network at Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 1.5 KM)

Contract No: HORC/HRIDC/CSYS-1/2023

Name of the Bidder/ Bidding Firm / Company :

PRICE SCHEDULE: Schedule A

(This BOQ template must not be modified/replaced by the bidder and the same should be uploaded in relevant columns, else the bidder is liable to be rejected for this tender. Bidders are allowed to enter only numerical values only)

NUMBER #	TEXT #	TEXT #	UNIT	RATE IN Rs. P	TOTAL AMOUNT With Taxes Rs. P	TOTAL AMOUNT In Words
1.01	Schedule A: Lumpsum component of Work	Lump Sum		0.00	INR Zero Only	
Total in Figures					0.00	INR Zero Only
Quoted Rate in Words					INR Zero Only	

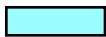


**Tenderer is only required to fill the information in the boxes highlighted with cyan colour in Price Schedule (Excel sheet)*

Price Schedule

(Please refer Price Schedule uploaded on eProcurement portal)

Validate	Print	Help	e BoQ			
Tender Inviting Authority: Haryana Rail Infrastructure Development Corporation Limited						
Name of Work: Contract Package SYS-1: Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km (-)2.099 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 315 TKM)						
Contract No: HORC/HRIDC/SYS-1/2023						
Name of the Bidder/ Bidding Firm / Company :						
PRICE SCHEDULE: Schedule 'B'						
(This BOQ template must not be modified/replaced by the bidder and the same should be uploaded after filling the relevant columns, else the bidder is liable to be rejected for this tender. Bidders are allowed to enter the Bidder Name and Values only)						
NUMBER #	TEXT #	NUMBER	NUMBER #	TEXT	NUMBER #	TEXT #
Sl. No.	Item Description	Estimated Rate in Rs. P	PERCENTAGE RATE (%) to be entered by the Bidder	Select Excess or less	TOTAL AMOUNT With Taxes Rs. P	TOTAL AMOUNT In Words
1	Schedule 'B': OHE works for IR Connectivity and feeder (Harsana Kalan IR SSP to New Harsana Kalan OHE)					
1.01	Sub-Schedule B1: General	6,22,05,356.72		SELECT		INR Zero Only
1.02	Sub-Schedule B2: Concrete	2,17,55,696.79		SELECT	0.00	INR Zero Only
1.03	Sub-Schedule B3: Ferrous	6,03,82,141.87		SELECT	0.00	INR Zero Only
1.04	Sub-Schedule B4: Non Ferrous	1,99,79,771.73		SELECT	0.00	INR Zero Only
1.05	Sub-Schedule B5: Catenary and Contact Wire	4,73,84,141.87		SELECT	0.00	INR Zero Only
1.06	Sub-Schedule B6: Insulators			SELECT	0.00	INR Zero Only
1.07	Sub-Schedule B7: SCADA at Harsana Kalan	1,36,54,013.00		SELECT	0.00	INR Zero Only
1.08	Sub-Schedule B8: Non-Schedule	1,36,54,013.00		SELECT	0.00	INR Zero Only
Total in Figures					0.00	INR Zero Only
Quoted Rate in Words					INR Zero Only	

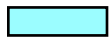


**Tenderer is only required to fill the information in the boxes highlighted with cyan colour in Price Schedule (Excel sheet)*

Price Schedule

(Please refer Price Schedule uploaded on eProcurement portal)

NUMBER #	TEXT #	NUMBER #	TEXT #
Sl. No.	Item Description	TOTAL AMOUNT With Taxes Rs. P Rs. P	TOTAL In Words
1.01	Schedule A: Lumpsum component of Works	0.00	INR Zero Only
1.02	Schedule B: OHE works for IR Connectivity and feeder (Harsan Kalan IR SSP to New Harsana Kalan OHE)	0.00	INR Zero Only
1.03	Provisional Sum	10,00,00,000.00	INR Ten Crore Only
Total in Figures		10,00,00,000.00	INR Ten Crore Only
Quoted Rate in Words		INR Ten Crore Only	



**Tenderer is only required to fill the information in the boxes highlighted with cyan colour in Price Schedule (Excel sheet)*

Section V - Eligible Countries

Eligibility for the Provision of Goods, Works and Non-Consulting Services in Bank-Financed Procurement

In reference to ITT 4.8 and 5.1, for the information of the Tenderers, at the present time, firms, goods and services from the following countries are excluded from this Tendering process:

Under ITT 4.8 (a) and 5.1: *None*

Under ITT 4.8 (b) and 5.1: *None*

Section VI - Prohibited Practices

1. The Bank requires that the Recipient (and all other beneficiaries of the Bank financing), as well as tenderers, suppliers, contractors, concessionaires and consultants under Bank-financed contracts for the Project, observe the highest standard of transparency and integrity during the procurement, execution and implementation of such contracts.
2. Definitions. In pursuance of this policy, the Bank defines the terms set forth below as Prohibited Practices:
 - (a) “**coercive practice**” means impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of a party to influence improperly the actions of a party;
 - (b) “**collusive practice**” means an arrangement between two or more parties designed to achieve an improper purpose, including to influence improperly the actions of another party;
 - (c) “**corrupt practice**” means the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party;
 - (d) “**fraudulent practice**” means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation.
 - (e) “**misuse of resources**” means improper use of the Bank’s resources, carried out either intentionally or through reckless disregard;
 - (f) “**obstructive practice**” means any of the following practices: (i) deliberately destroying, falsifying, altering or concealing of evidence material to a Bank investigation; (ii) making false statements to investigators in order to materially impede a Bank investigation into allegations of a Prohibited Practice; (iii) failing to comply with requests to provide information, documents or records in connection with a Bank investigation; (iv) threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to a Bank investigation or from pursuing the investigation; or (v) materially impeding the exercise of the Bank’s contractual rights of audit or inspection or access to information; and
 - (g) “**theft**” means the misappropriation of property belonging to another party.
3. Any occurrence, or suspected occurrence, of a Prohibited Practice in the procurement, award, or implementation of a Bank-financed contract is dealt with in accordance with the provisions of the Bank’s Policy on Prohibited Practices. Suppliers, contractors, service providers and consultants selected pursuant to the provisions of Section II and concessionaires selected pursuant to paragraph 14.3 of the Bank’s Procurement Instructions for Recipients, as well as the Recipient shall fully cooperate with the Bank (or a cofinancier undertaking an investigation pursuant to paragraph 6.1 of the Bank’s Procurement Instructions for Recipients) in any

investigation into an alleged Prohibited Practice to be carried out pursuant to the Policy on Prohibited Practices, and permit the Bank or its representative (including such co-financier) to inspect such of their accounts and records as may be relevant for such investigation and to have such records and accounts audited by the auditors appointed by the Bank.

4. Provisions to this effect are included in the Legal Agreements and the procurement contracts with such entities.
5. If the Project is financed by a sovereign-backed loan, the Bank (or, where relevant, a co-financier having undertaken an investigation pursuant to paragraph 6.1 of the Bank's Procurement Instructions for Recipients):
 - (a) may take any of the following additional actions in connection with a Prohibited Practice under the Project:
 - (i) reject a proposal for award if it determines that the tenderer recommended for award, or any of its personnel, or its agents, or its sub-consultants, subcontractors, service providers, suppliers or their employees, has, directly or indirectly, engaged in a prohibited practice in competing for the contract in question; and
 - (ii) cancel the undisbursed portion of the loan allocated to a contract (and require reimbursement of the disbursed portion of the loan allocated to the contract) if it determines at any time that representatives of the Recipient or of a recipient of any part of the proceeds of the loan engaged in a prohibited practice during the procurement, administration or implementation of the contract in question; and
 - (b) requires that a clause be included in tender documents and in contracts financed by the Bank loan, requiring tenderers, suppliers and contractors, and their subcontractors, agents, personnel, consultants, service providers, or suppliers, to permit the Bank (and a co-financier undertaking an investigation pursuant to paragraph 6.1 of the Bank's Procurement Instructions for Recipients) to inspect all accounts, records, and other documents relating to the submission of tenders and contract performance, and to have them audited by auditors appointed by the Bank.

Final Tender Document for Works

(Two-Envelope Tendering Process Without Prequalification)

Procurement of:

Contract Package SYS-1: Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km (-)2.099 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e. from km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 315 TKM).

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CHAPTER 1 - INTRODUCTION & SCOPE

1.1 INTRODUCTION

- 1.1.1 Haryana Rail Infrastructure Development Corporation Limited (HRIDC) was Incorporated on 22nd August 2017 as a Joint Venture between Government of Haryana and Ministry of Railways with equity Participation of 51% and 49% respectively. The Haryana Orbital Rail Corridor (HORC) project is from Prithla (near Palwal station of Indian Railways) to New Harsana Kalan (near Sonapat station of Indian Railways) of HRIDC.
- 1.1.2 Haryana Orbital Rail Corridor (HORC) route will be approximately 145 RKM and 315 TKM from Prithla to New Harsana Kalan including connectivity to Indian Railway (IR) and Dedicated Freight Corridor Corporation of India Limited (DFCCIL) stations.
- 1.1.3 There are 17 New Stations namely Prithla, Silani, Sohna IMT, Dhulawat, Chandla Dungerwas, Panchgaon, Manesar, New Patli, Badsa, Deverkhana, Badli, Mandothi, New Asaudah, Jasaur Kheri, Kharkhoda, Tarakpur and New Harsana Kalan.
- 1.1.4 Out of 17 stations, 4 are Junction Stations namely Manesar, New Patli, Badsa and Mandothi and are proposed with proper connectivity with IR stations. The Prithla station (HORC) with High Rise OHE is connected by double lines with New Prithala station of DFCCIL with High Rise OHE and also to DFCCIL line at Prithla with single line, New Patli station (HORC) with High Rise OHE is connected by single line with IR Patli station with High Rise OHE at chainage 3.000 km (from Ch 0.000 km at New Patli station). The New Patli station (HORC) with High Rise OHE is connected by single line to Sultanpur station (IR) with High Rise OHE. Sultanpur (IR) station with High Rise OHE is connected by single line to Badsa station with High Rise OHE. Mandothi station (HORC) with High Rise OHE is connected by single line with Asaudah station of IR with normal OHE. The Manesar station (HORC) with High Rise OHE is connected with the Maruti Suzuki factory siding with High Rise OHE and also connected with IR Patli station with High Rise OHE and work is being executed by another agency. The proposed double lines (HORC) will be ending at New Harsana Kalan station. The new Harsana Kalan (HORC) station (with High Rise OHE) shall be connected by double lines with Harsana Kalan station of IR with normal OHE).
- 1.1.5 The Proposed Corridor between New Prithla – New Harsana Kalan having a total of approx. 145 RKM and 315 TKM. The Section is proposed to be electrified with 2x25 kV, AC, 50 Hz, High Rise OHE. Rigid Overhead Conductor System (ROCS) shall be provided in twin tunnels from km 24.850 to km 29.580 between IMT Sohna and Dhulawat station. here is viaduct between Sohna IMT station and tunnel from km 20.915 to km 24.843.
- 1.1.6 The bridges and formation will be designed for 32.5T axle load while the track structure will be designed for 25T axle load operating at train speed of up to 160 Kmph. There shall be 3 RFOs (Railway Fly Overs) over Delhi -Rewari, BG, Double Line, Electrified with High Rise OHE at Patli; over Garhi Harsaru – Farukh Nagar, BG Single Line, Electrified with High Rise OHE at Sultanpur; and Delhi – Rohtak, BG, Double Line, Electrified with normal OHE at Asaudah.
- 1.1.7 The proposed HORC Railway Lines shall handle Goods as well as Passenger traffic.

1.2 OBJECTIVE

1.2.1 The objective of the Bid document is execution of design, manufacture, supply, construction, installation, testing and commissioning of High Rise 2x25kV, 50Hz, AC, Electric Traction System, Power Supply System, Overhead Equipment (OHE) & Rigid Overhead Conductor System(ROCS), Supervisory Control & Data Acquisition (SCADA) System, Single Phase 240V power supply by installing 25kV/240V auxiliary transformers at signal & telecom huts, and stations including other associated works for New Prithla to New Harsana Kalan of the HORC Project, as a Design and Build Package.

1.3 PROJECT INFORMATION FOR PRITHLA – NEW HARSANA KALAN SECTION

Package	HORC Chainage		Approx. Total Route Length	Remarks
	From	To		
SYS-1: Pirithla – New Harsana Kalan and connectivity at New Prithla, Prithla, Sultanpur, Asaudah and New Harsana Kalan	Km(-)2.099	Km 125.98	Km (-) 145	Tunnel from km 24.850 to km 29.580

1.3.1 Station Buildings, Depots and Service Buildings

The list of Station Buildings, Depots and Service Buildings in the Pirithla – New Harsana Kalan section are detailed as under:

a) JUNCTION STATIONS

There are 4 junction stations in this section namely Manesar, New Patli, Badsa and Mandothi.

b) CROSSING STATIONS

The list of Junction stations and Crossing stations along with their indicative chainages is as detailed below:

SN	Station	Chainage (km)
1	Prithla	0.00
2	Silani	10.40
3	Sohna IMT	19.01
4	Dhulawat	32.77
5	Chandla Dungerwas	42.60
6	Panchgaon	46.29
7	Manesar	51.89
8	New Patli	58.00
9	Badsa	64.75
10	Deverkhana	71.14
11	Badli	76.83

**Part-2, Section VII-1: Employer's Requirements - General Specifications (GS)- 2x25 kV AC
Traction Electrification and associated work**

12	Mandothi	90.45
13	New Asaudah	94.03
14	Jasaur Kheri	100.22
15	Kharkhoda	108.72
16	Tarapur	114.20
17	New Harsana Kalan	125.13

1.3.2 The OHE and PSI Depot for maintenance shall be constructed at Manesar by other contractor.

1.3.3 LEVEL CROSSINGS

There are no Level Crossings in the works. *However, if there is any level crossing encountered during execution of the Works, the cost of Electrical works required in connection with level crossings shall be paid under Schedule 'B'.*

1.3.4 The salient features of the Track Structure and Formation on Prithla – New Harsana Kalan of HORC are as follows:

Sr.	Description	Details & Particular
1.	Gauge	1676 mm
2.	Main Line, Loops and Sidings	60 kg Rail, 1 in 12 thick web and curved switches with CMS Crossings on Fan shaped PSC Sleepers layout
3.	Sleepers	PSC Mono-Block
4.	Formation Width	For Double line : 13160 mm minimum For Single line : 7850 mm
5.	Radii of curves	Shall generally be not less than 700 meters on HORC main lines (2.5 degrees), <i>Connectivities to IR will have curvature up to 6 degree.</i>
6.	Maximum gradient	1: 150 compensated

1.3.5 Operation Control Center Facilities

1) A Centralized Operational Control Centre (OCC) for entire HORC shall be located at Manesar. The OCC shall house the 'Train Management System' 'Traction Power SCADA' and 'Auxiliary SCADA' Control for HORC. All the controllers such as Traffic Controllers, Track Controller, Traction Power Controllers, and Signal Fault Controller etc. shall monitor and manage all train operations and associated activities, including maintenance of entire HORC from the OCC.

1.4 CONTRACT PACKAGES FOR PIRTHLA - NEW HARSANA KALAN SECTION

1.4.1 The work of Pirthla – New Harsana Kalan Section has been divided in different packages as given under Sub-Clause 2.3 of Section VII-2: Particular Specification (PS).

1.5 SCOPE OF WORK

1.5.1 The Scope of Work is comprised of Design, Manufacture, Procure/Supply, Construct/Install, Build, Testing and Commissioning of 2x25kV AC Electrification and associated Works, as required for safe and reliable operation for Pirthla – Harsana Kalan section of HORC. The details of track sections, stations, LC gates, Maintenance depots, OCC, service buildings etc covered under HORC are given in clauses above. The Work shall be executed based on “Employer’s Requirements” as detailed in this “**General Specifications**” and the “**Particular Specifications**” as specified below and other documents included in this Bid:

a. Section VII-1: General Specifications,

It describes the Employer’s General Requirement for execution of the 2x25kV AC Electrification and associated works for Pirthla – New Harsana Kalan section of HORC.

b. Section VII-2: Particular Specifications-2x25kV, AC, Traction Electrification and associated Works,

It describes the Employer’s Requirement and the scope of work for execution of 2x25 kV, AC, Traction Electrification and associated works for Pirthla – New Harsana Kalan section of HORC.

c. Section VII-3: Tender Drawings

It contains the list of drawings and documents required for the works of HORC.

1.5.2 Permanent Works

All works required for Electrification (2x25 kV) and associated works for Pirthla – New Harsana Kalan section as per the details identified in Section VII-1,2 &3 of this document except temporary works are required for facilitation and delivery.

Note: - Construction of Traction Sub stations, Switching Stations and Auxiliary substations works and SCADA are also part of this Contract Package.

1.5.3 Temporary Works

- a) The Contractor shall execute all Temporary Works required to facilitate construction/Installation of permanent works.
- b) All temporary arrangements and Works shall be designed and necessary drawings developed to ensure that these remain safe during construction/Installation.
- c) As a rule, temporary Works shall be subsequently dismantled and removed by the Contractor after construction/installation, at his own cost. The Engineer, however, may permit retention of some of the temporary works with mutual consent between the Contractor and the Engineer.

1.5.4 Approvals / Clearance and Certification

The Contractor shall be fully responsible for timely planning and obtaining;

- a) Relevant certificates, approvals or clearances from local/civil authorities viz. completion certificate, fire clearance or any other mandatory clearances as required,
- b) All necessary approvals for the drawings including General Arrangement Drawings (GADs) from the concerned Railway/ State/ Local authorities before the

commencement of construction,

- c) Relevant certificate(s) and/ or clearance(s) from local / civil authorities/ Commissioner of Railway Safety (CRS)/ Electrical Inspector to the Government of India (EIG) / Dot Clearance.

(End of Chapter 1)

CHAPTER 2 - GENERAL

2.1 DEFINITIONS AND INTERPRETATIONS

In addition to the words and expressions defined in the Conditions of Contract, following words and expressions shall have the meaning assigned to them except where the context otherwise requires:

- (1) **“As-Built Documents”** means those drawings & documents produced by the Contractor and endorsed by it as true records of construction/Installation of the Permanent Works and which have been agreed with the Engineer.
- (2) **“Auxiliary Signals”** Shunt signals – Independent or below Main Signals, Calling- on signals, Route indicators, 'A' marker & 'AG' marker lights for Semi-Automatic signals.
- (3) **“Availability”** The probability that an item will be in a state to perform a required function under given conditions at a given instant of time or over a given time interval assuming that the required external resources are provided.
- (4) **“Apportionment”** process whereby the RAMS elements for a systems are sub- divided between the various items which comprise the system to provide individual targets.
- (5) **“Chainage”** means a term often used for all Indian Projects. It is not a unit of measurement. It merely denotes the location of any particular point on DFCC/IR alignment. For example, the location of a point is 23.502 denotes the location of a point is at a distance of 23502 metres from the zero point. In Indian parlance 23.502 is termed as “Chainage” of that point.
- (6) **“Combined Services Drawings”** means drawings showing the services details of all the Utilities in a combined drawing indicating locations, layouts and sizes of all electrical and mechanical services.
- (7) **“Compliance”** demonstration that a characteristic or property of a product satisfies the stated requirements.
- (8) **“Condition of Contract”** shall means General Conditions of Contract read in conjunction with Particular Conditions of Contracts as in Part 3 of Bidding Documents.
- (9) **“Commencement Date”** means the date of as defined in Particular Conditions of Contract.
- (10) **“Construction/Installation and/or Manufacture Documents”** means all documents ,drawings, calculations, computer software, samples, patterns, models, operation and maintenance manuals and other manuals and information of a similar nature submitted by the Contractor.
- (11) **“Construction/ Installation Drawings”** shall be derived directly from the Detailed Design and shall detail and illustrate in full the Permanent & Temporary Works. These drawings /documents are the ones which the Contractor considers sufficient in detail for construction/Installation and is cleared by the Engineer for construction/Installation.
- (12) **“Control Terminal”** An Industrial grade computer completes with hard disc, VDU display monitor, key board and mouse, as required.
- (13) **“Corrective Maintenance”** means maintenance performed to correct the occurrence of an equipment or system fault.

- (14) **“Defect”** is any part of the Work which is not in accordance with the Contract.
- (15) **“Detailed Design”** prepared and accepted part of drawings, documents, standards and instructions which is the authorization for manufacture, Procure/supply, construction/Installation and testing. "Detailed Design" has the meaning identified in Chapter-6 of this GS.
- (16) **“Detailed Design Submission”** means the submission of Contractor's Documents which comprise the whole or part(s) of the proposed Detailed Design and for which the Contractor seeks a Notice.
- (17) **“Design Criteria”** means the governing specifications and conditions as specified in Employer's Requirements as detailed in GS and PS.
- (18) **“Design Data”** means all survey and investigations, specifications, plans, drawings, details, graphs, sketches, models, levels, setting-out dimensions, calculations and other documents related to the design of the Works.
- (19) **“Design life”** The design life is the period of time during which the system is expected to work satisfactorily within its specified parameters.
- (20) **“Design Manual”** means the manual to be prepared and submitted by the Contractor as part of the Preliminary Design and as described in Chapter-6 of this GS of the Bidding Documents as applicable.
- (21) **“Design Phase”** has the meaning identified in Chapter-6 of This GS.
- (22) **“Designer”** means the Contractor or part of the group forming the Contractor, person, firm or company or group of companies or any replacement carrying out the Design of Works or part thereof.
- (23) **“Down Time”** time interval during which a product is in a down state.
- (24) **“Drawings”** means the Employer's Indicative Drawings and the Drawings submitted by the Contractor and modification of such drawings, if any, furnished from time to time or for which the Engineer has issued a Notice of No Objection.
- (25) **“Employer”** means the Haryana Rail Infrastructure Development Corporation Limited (HRIDC) or the person named as Employer and the legal successors in title to this person.
- (26) **“Employer's Personnel”** means the person so authorized for the purpose of Contract Execution.
- (27) **“Employer's Representative”** means the person so authorized by the Employer for the specific purpose of Contract Execution.
- (28) **“Engineer”** means the person so authorized for the purpose of Contract Execution.
- (29) **The “Engineer”** means the General Consultant (GC) Representative / the person appointed by the Employer to act as the Engineer for the purposes of the Contract or other person appointed from time to time by the Employer and notified to the Contractor.
- (30) **“Factory Acceptance Tests”** Type/Routine/ acceptance/special Tests as specified in relevant standards & specifications as needed before dispatch of material and conducted at the premises of Original Equipment Manufacturer.
- (31) **“Failure Mode”** predicted or observed results of failure cause on a stated item in relation to the operating conditions at the time of the failure.
- (32) **“Flank Protection”** Protection of a train running on route set for it from trains

or vehicles on neighboring lines through setting & locking of concerned points in required position is called Flank protection.

- (33) **“Hazard”** Physical situation with a potential for human injury and / or damage to environment.
- (34) **“Interfacing Contractor”** means the Contractor engaged by the Employer or other agencies having an interface issue with the Contractor for this Work.
- (35) **“Interfacing Parties”** comprises of the designated contractors/ consultants/ service providers, other Contractors who are engaged in part of the works and relevant statutory authorities, relevant public utility agency and adjacent contractors who are or will be working adjacent to the site.
- (36) **“Interface coordinator”** is an official appointed by the contractor to Coordinate the Interface requirement and organize the interaction between interfacing parties and organize interface.
- (37) **“Interface Manager”** Is the official appointed by the contractor, directly Responsible to identify, assess the interface requirement with other systems and incorporate in the Detailed Interface Designs to identify the boundaries of responsibilities, get it agreed with interfaced parties and manage the interface requirement within its agreed scope.
- (38) **“Level Crossing”** Is the rail – road surface crossing.
- (39) **“Line Replaceable Unit (LRU)”** means equipment that can be replaced as a single complete unit and can be handled by a single person.
- (40) **“Main running signals”** Home signal, Starter signal, Intermediate Starter signal, Advance Starter signal and Gate signals.
- (41) **“Maintainability”** A characteristic of design and installation, expressed as the probability that an item will be retained in or restored to a specified condition within a given period of time, when the maintenance is performed in accordance with prescribed procedures and resources.
- (42) **“Man Machine Interface (MMI)”** means the visual interface between the Controller and the control system. The MMI consists of the computer screen, displayed objects, icons, and equipment as well as the facilities by which the Controller executes control.
- (43) **“Mean Time to Restore (MTTR)”** means the average time to restore equipment, subsystems, system to full functionally.
- (44) **“Milestone”** means as defined in Particular Conditions of Contract in Part 3 of Bid Document.
- (45) **“Milestone Date”** means the date, prescribed in Particular Conditions of Contract in Part 3 of Bid Document, by which a Milestone is to be achieved.
- (46) **“Milestone Certificate”** means the certificate to be issued by the Engineer in relation to the achievement or otherwise of Milestones.
- (47) **“Notice”** means a Notice of No Objection.
- (48) **“Other Contractor”** means Contractor(s) other than that for this package i.e. SYS-1.
- (49) **“Outline Quality Plan”** means the quality plan setting out in summary form, the Contractor's proposed means of complying with his obligations in relation to quality assurance as prescribed in the Employer's Requirements.

- (50) **“Outline Safety Plan”** means the safety plan setting out in summary form, the Contractor's proposed means of complying with his obligations in relation to construction/Installation safety as prescribed in the Employer's Requirements.
- (51) **“Operating Hours”** means operating hours for Train Operation in EDFC.
- (52) **“Particular Specification”** means the Specifications prepared for the purpose as enclosed in Part – 2, Section VII-2.
- (53) **“Permanent Work”** means the permanent works to be designed and executed by the Contractor under the scope of work covered in this GS and relevant PS.
- (54) **“Plan”** means a scheme or method or procedure statement/ document of doing/ proceeding / making developing in advanced to achieve a desired goal/ objective within a specific time frame.
- (55) **“Preliminary Design”** means the submission of Contractor's Documents which comprise the initial stage of the design phase. It is a basically a concept scheme design.
- (56) **“Preliminary Drawings”** means the drawings prepared by the Contractor that are built on the Reference Drawings and accompany the Contractor's Preliminary Design submissions.
- (57) **“Program”** means a time schedule or Program or Program which has been developed for delivery of a particular purpose or any activity in a time a frame. It is same as “Program”.
- (58) **“Pull-down Menu”** means a list of items displayed by clicking mouse, arranged in the downward direction.
- (59) **“Pull-up Menu”** means a list of items displayed by clicking mouse, arrange in the upward direction.
- (60) **“Possession”** means taking a section of the IR line(s) out of service.
- (61) **“Railway”** means Railway or any portion of a Railway for public carriage of passengers and goods including dedicated freight corridors.
- (62) **“Railway Envelope”** means the zone or zones which contain the track, platforms and equipment necessary for the operation of the railway by the HORC.
- (63) **“Reference Drawings”** means the drawings prepared by the Employer and included in the bidding document.
- (64) **“Reliability”** The probability that an item/equipment/system can perform a required function under given conditions for a given time interval.
- (65) **“Reliability growth”** means a condition characterized by a progressive improvement of a reliability performance measure of an item with time.
- (66) **“Right of Way”** means the width/area of the land acquired/being acquired for the operation of the railway. Right of way for HORC project has been indicated in Part -2, Section VII-3: drawings and documents.
- (67) **“Running Lines”** The Indian Railway Lines at connecting stations.
- (68) **“Safety”** Freedom from unacceptable risk.
- (69) **“Safety Integrity Level”** means a number identifying discrete level for specifying the safety integrity requirements of the safety functions to be allocated to the safety related systems. Safety Integrity Level with the highest figure has the highest level of safety integrity.

- (70) **“Safety-Critical”** means failure of the system, sub-system or equipment that directly leads to a situation with the potential to cause harm, injury to humans, damage to property, plant or equipment, damage to the environment, or economic loss.
- (71) **“Safety Procedures”** these shall be the procedures as detailed in Chapter-9: “Site Safety Plan” of this GS.
- (72) **“Schedule of Milestones”** means the schedule included Part-3 of Bid Document.
- (73) **“Site”** means the area where the Permanent Works are executed in the Right of Way or adjoining the Right of Way.
- (74) **“Stations”** means Railway stations belonging to IR or HORC.
- (75) **“System Acceptance Tests”** means those tests that demonstrate the performance of the installation / equipment to the specified requirements as detailed in the Particular Specifications.
- (76) **“System Contractor”** means the Contractor engaged by the Employer to carry out Works related to Systems part of the project.
- (77) **“System Works”** means the works to be carried out by the Contractor(s) engaged by the Employer to carry out Works related to ‘Design, Construct/Install, Manufacture, Procure/Supply, Build, Testing and Commissioning of 2x25kV AC Electrification and associated works’ as part of the project for the HORC Railway line under construction on Design-Build lump sum basis from Pirthla – New Harsana Kalan Section of HORC including removal of any temporary works as included in the scope of Work of the Employer’s Requirement.
- (78) **“Technical Specifications”** means the combined specifications prepared by the Contractor in a format which combines the Technical Specifications and those parts of the Contractor's Technical Proposals which specify standards for design, procurement, manufacture, Procure/supply construction/Installation, testing and commissioning which are developed during the Design Phase and fully comply with the Employer’s requirements.
- (79) **“Temporary works”** means all Temporary Works of every kind (other than Contractor’s Equipment) required on Site for the execution and completion of the Permanent Works and the remedying of any defects.
- (80) **“Train Operator/Driver”** means the person(s) on the trains responsible for its operation.
- (81) **“TMS terminal”** A terminal having MMI device with video display unit (VDU), Keyboard and mouse.
- (82) **“Validation”** means confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use have been fulfilled.
- (83) **“Video wall”** A graphical representation of the 2x25 kV AC Traction Electrification, E&M and Train Management System and its global operating status.
- (84) **“Works”** means the work, both permanent and temporary or services to be carried out, survey and investigation, designed, manufactured, fabricated, delivered to Site, erected, installed, completed, tested, commissioned, (including Integrated Testing and Commissioning) or supplied in accordance with the Contract and include Plant, Equipment and Material and their accessories.

- (85) **“Work Stations”** means the collection of processors, screens and input devices necessary to provide the controller or maintenance personnel with necessary system displays and commands.
- (86) **“Working Drawings”** comprise the Construction reference drawings such as construction/Installation drawings, manufacturing drawings and testing and commissioning documents, as are necessary to amplify the Good for construction/Installation Drawings for construction/Installation etc. purposes and endorsed, as required by the Engineer.
- (87) **“Works Program”** means the Program showing list of activities as per the sequence, Duration, start date, finish date, float/ cushion if any, method and timing of Verification/Investigations, design stages, submission date, Date for issue of No Objection Notices, execution (start/ finish), Procurement, manufacture, FAT, delivery to site, access hand over date, Development of Mockup, erection, installation, RAMS demonstration, testing, commissioning of the Works (including Integrated Testing and Commissioning), indigenization (where applicable) and related activities in the form and content prescribed by the Employer’s Requirements, or any amended or varied version thereof, as submitted by the Contractor and for which the Engineer has issued a Notice of No Objection.

2.2 ABBREVIATIONS AND ACRONYMS

Abbreviation	Description
AC	Alternating Current
ACTM	AC Traction Manual
ASM	Assistant Station Master
Aux AT	Auxiliary Transformers
AT	Auto Transformer
ALARP	As Low as Reasonably Practicable
BS	British Standards
BIS	Bureau of Indian Standards
BTS	Base Transceiver Station
CAD	Computer Aided Design
CENELEC	European Committee for Electro Technical Standards
CHC	Chief Controller
CIP	Co-ordinated Installation Plan
CP	Contract Package
CPCB	Centre Pollution Control Board
CPM	Critical Path Method
CRS	Commissioner for Railway Safety
CSD	Combined Service Drawings
CST	Civil, Structure and Track
CV	Curriculum-Vitae
DC	Direct Current
DDF	Digital Distribution Frame

**Part-2, Section VII-1: Employer's Requirements - General Specifications (GS)- 2x25 kV AC
Traction Electrification and associated work**

dB	Decibel
DCN	Design Change Notice
DFC	Dedicated Freight Corridor
DFCC	Dedicated Freight Corridor Corporation
DFCCIL	Dedicated Freight Corridor Corporation of India Limited
DL	Double Line
DNP	Defect Notification Period
DPR	Detailed Project Report
DT	Down Time
DTN	Data Transmission Network
DVT	Design Verification Table
DVV	Design Verification and Validation
E & M	Electrical and Mechanical
EDFC	Eastern Dedicated Freight Corridor
EIG	Electrical Inspector to the Government of India
EI	Electronic Interlocking
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
EMP	Environmental Management Plan
EN	Euro Norm
ERP	Enterprise Resource Planning
<i>ESHS</i>	<i>Environment, Social, Health and Safety</i>
Excl.	Excluding
FAT	Factory Acceptance Test
FCN	Field Change Notice
FIU	Field Interface Unit
FMEA	Fault Mode and Effects Analysis
FMECA	Failure Modes Effect and Criticality Analysis
FRCAS	Failure Recording And Corrective Action System
FTA	Fault Tree Analysis
GE	Geotechnical Engineering
GSM-R	Global System for Mobile Communication – Railway
GWR	Gate Working Rules
G&SR	General and Subsidiary Rules
GAD	General Arrangement Drawing
GCC	General Conditions of Contract
GS	General Specification
HRIDC	Haryana Rail Infrastructure Development Corporation Limited
HORC	Haryana Orbital Rail Corridor
HT	High Tension

**Part-2, Section VII-1: Employer's Requirements - General Specifications (GS)- 2x25 kV AC
Traction Electrification and associated work**

HTML	Hyper Text Markup Language
HAZOP	Hazard and Operability Studies
HF	High Frequency
HDD	Hard Disc Drive
HDPE	High Density Poly Ethylene
Hz	Hertz
ID	Identification
ICD	Interface Co-ordination Document
IEEE	Institute of Electrical and Electronics Engineers
IEC	International Electro – technical Commission
IHA	Interface Hazard Analysis
Incl.	Including
IMD	Integrated Maintenance Depot
IMSD	Integrated Maintenance Sub Depot
IMP	Interface Management Plan
INR	Indian Rupees
IPS	Integrated Power Supply
IR	Indian Railway
IRS	Indian Railway Standards
IRSEM	Indian Railway Signal Engineering Manual
IS	Indian Standard
ISO	International Standards Organization
IT	Information Technology
Km / KM	Kilo Meter
KMPH	Kilo Meter Per Hour
KV	Kilo Volt
KVA	Kilo Volt Ampere
LED	Light Emitting Diode
LT	Low Tension
LC	Level Crossing
LRU	Line Replaceable Unit
LIU	Line Interface Unit
M & P	Machines and Plants
MACLS	Multiple Aspect Colour Light Signalling
MCB	Miniature Circuit Breaker
MCIL	Maintainability Critical Items List
MDF	Main Distribution Frame
MDT	Mean Down Time
MTBSAF	Mean Time Between Service Affecting Failure
MMD	Maximum Moving Dimensions

**Part-2, Section VII-1: Employer's Requirements - General Specifications (GS)- 2x25 kV AC
Traction Electrification and associated work**

MMI	Man Machine Interface
MOR	Ministry of Railway
MPR	Monthly Progress Report
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
MTTR	Mean Time To Restore
NABL	National Accreditation Board for Laboratories
NMCP	Noise Monitoring and Control Plan
NOC	No Objection Certificate
O & M	Operation and Maintenance
O&SHA	Operating and Support Hazard Analysis
OCC	Operations Control Centre
ODBC	Open Data Base Connectivity
ODF	Optional Distribution Frame
OEM	Original Equipment Manufacturer
OFC	Optic Fiber Cable
OHE	Over Head Equipment
OHTL	Over Head Transmission Lines
OPM	Other Preventive Measures
PBX	Private Branch Exchange
PC	Personal Computer
PHA	Preliminary Hazard Analysis
PMIS	Project Management Information System
PS	Particular Specifications
PVC	Poly Vinyl Chloride
QA	Quality Assurance
RAM	Reliability, Availability & Maintainability
RAMS	Reliability, Availability, Maintainability and Safety
RAP	Resettlement Action Plan
RBD	Reliability Block Diagram
RCIL	Reliability Critical Item List
RDSO	Research Design and Standards Organization
RDT	Reliability Demonstration Testing
RE	Railway Electrification
ROB	Road Over Bridge
ROW	Right Of Way
RUB	Rail Under Bridge
SAT	System Acceptance Test
SCIL	Safety Critical Items List
SCADA	Supervisory Control And Data Acquisition

**Part-2, Section VII-1: Employer's Requirements - General Specifications (GS)- 2x25 kV AC
Traction Electrification and associated work**

SER	Signalling Equipment Room
SHE	Safety, Health and Environment
SIL	Safety Integrity Level
SL	Single Line
SM	Station Master
SOD	Schedule of Dimensions
SOGP	Schedule of Guaranteed Performance
SP	Sectioning & Paralleling Post
SSP	Sub Sectioning & Paralleling Post
SPM	Suspended Particulate Matter
SRS	System Requirement Specification
SSP	Sub-Sectioning Post
SSHA	Subsystem Hazard Analysis
S & T	Signaling & Telecommunication
SWR	Station Working Rules
TER	Telecommunication Equipment Room
T&P	Tools & Plants
TMS	Train Management System
TOT	Transfer of Technology
TPC	Traction Power Controller
TSS	Traction Sub Station
UIC	International Union of Railways
UPS	Uninterruptible Power Supply
VAT	Value Added Tax
VDU	Video Display Unit
VRLA	Valve Regulated Lead Acid
VHF	Very High Frequency
WGS	World Geodetic System

2.3 APPLICABILITY OF GENERAL SPECIFICATIONS AND RELEVANT DOCUMENTS

- 2.3.1 The provisions contained in the Particular Specification (PS) shall prevail over the provisions contained in this GS.
- 2.3.2 These documents shall be read in conjunction with the Conditions of Contract (General and Particular), Employer's Requirement and any other document forming part of the Contract.
- 2.3.3 This design-build contract shall be fulfilled, managed and commissioned in accordance with the applicable legislation in India, specific IR regulations/ International/ National standards as specified.

2.4 REFERENCE DOCUMENTS

Reference Documents as relevant for the package i.e drawings, alignment plans etc are Part 2, Section VII-3: Tender Drawings.

2.5 CODES & STANDARDS

- 2.5.1 Equipment, material and systems/sub-systems shall be designed, manufactured and tested in accordance with the latest issue of approved and recognized codes and standards defined and proposed by the Contractor and approved for the Work. All standards, codes and manuals with correction slips issued up to 28 days prior to last date of first stage of Bid submission shall be applicable for this bid. Any other applicable code, circular, instruction of UIC shall be referred with the approval of the Engineer.
- 2.5.2 References to standards or to material and equipment of a particular manufacturer in these contract documents shall be regarded as followed by the words or equivalent.
- 2.5.3 The Contractor shall supply to the Engineer, two authorized and original full editions of the publications (such as, but not limited to, Technical Standards and Codes of Practice), the codes and standards proposed /used for carrying out the Designs, Contractor's Documents, the Drawings and other communications relevant to this Contract. These publications shall be for the sole use of the Engineer and Employer and, upon completion of the Contract, shall become the property of the Employer.
- 2.5.4 The Contractor shall ensure that items of equipment and their components are standardized wherever possible throughout the Works where similar requirements and functions exist.
- 2.5.5 The Contractor shall submit design to the Engineer for review and no objection. The proposed standards used shall also be referred with the design listed in the Employer's Requirements. The Contractor may propose an alternative equivalent international standard during the design stage but the acceptance of the alternative standard shall be subject to review by the Engineer.
- 2.5.6 *RDSO Vendor directory along with Standards and Specifications can be accessed at the following URL given below :*
<https://www.ireps.gov.in/epsn/cvap/admintab/vndrDirectoryAnon.do?activity=displayFirst&approvAgencyCode=-2>

2.6 SCHEDULE OF DIMENSIONS AND CLEARANCES

- 2.6.1 The Permanent works shall not infringe the Standard Schedule of Dimensions (SSOD) of Indian Railways, 1676 mm Gauge, BG, Revised, 2022 (with latest Addendum & Corrigendum Slips) and land boundary limits of HORC as shown on the drawings as listed in Section VII-3.
- 2.6.2 In addition, the Contractor shall formulate all necessary drawings, plans, documents etc. in accordance with the applicable legislation in India, in compliance with the Contractor definitive design for all clearances.

2.7 SPECIFICATIONS

- 2.7.1 The **Technical Specifications** for the Work shall be in accordance with the requirement detailed in Part – 2, Section VII: General Specifications & Particular Specifications.
- 2.7.2 In accordance with the provisions of these documents, the Contractor shall develop the System Requirement Specifications (SRS) during the Design stage and submit along with the Inception Report. The SRS compliance shall be submitted as part of the Detailed Design Submission along with the Schedule of Guaranteed Performance (SOGP) proposed by the vendor of the equipment selected and as desired & approved by the Engineer.

2.7.3 When the Specifications have received a 'Notice of No Objection' from the Engineer, these shall become the Technical Specifications.

2.8 LANGUAGE OF CONTRACTOR'S DOCUMENTS

All documents, reports, drawings, calculations and correspondence and the like shall be submitted by the Contractor in English.

2.9 PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)

2.9.1 The Contractor shall utilize a Proven PMIS such that all documents generated by the Contractor can be transmitted to the Engineer through electronic means and traceable.

2.9.2 The PMIS shall also allow all documents generated by either party to be electronically captured at the point of origin and be reproduced later, electronically and in hard copy.

2.9.3 The requirements of PMIS are explained in Chapter 15, Appendix-7- "PMIS Requirement and Procedures".

2.10 PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHTS

2.10.1 The patent, copyright or other intellectual property rights in any Plant, Design Data, plans, calculations, drawings, documents, material, know-how and information relating to the Works shall be vested with the Contractor. The Contractor shall grant to the Employer, his successors and assignees, a royalty-free, nonexclusive and irrevocable license to use and reproduce any of the Works, Designs or inventions incorporated and referred to in such plant, documents or material and any such know-how and information for all purposes relating to the Works, including without limitation, the design, manufacture, installation, reconstruction, testing, commissioning, completion, reinstatement, extension, repair and operation of the Works.

2.10.2 Infringement of Patent Rights

The Employer shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, use of similar components in the design and development of any system/sub system(s) or due to any other factor not mentioned herein which may cause a dispute. The entire responsibility to settle any such disputes / matters shall lie with the Contractor.

2.11 PUBLICITY

The Contractor / Sub-Contractor(s) shall not publish, present at seminars, forums or otherwise circulate, alone or in conjunction with any other person, any article, photograph or other material relating to the Contract, the Site, the Works, the Project or any part thereof, nor part with the Press, or any radio or television network, any information relating thereto, nor allow any representative of the media access to the Site, Contractor's Works Areas, or off-Site place of manufacture, or storage except with the permission, in writing, of the Employer. The provisions of this Sub-Clause shall not exempt the Contractor from complying with any statutory provision in regard to the taking and publication of photographs.

2.12 GUARANTEE/ WARRANTY CERTIFICATES OF OEM

All Original Guarantee/Warranty Certificates of OEMs should be registered in the name of HRIDC. These Guarantee/warranty certificates received from the OEMs should be passed on to HRIDC.

2.13 SURVEY AND SITE INVESTIGATIONS

The Contractor shall carry out all necessary surveys and all further site investigations as required for the design of the system works and to enable the determination of the methods of construction / Installation and the nature, extent and design of the Temporary Works.

It is Contractor responsibility to obtain all necessary permissions, approvals etc. from landowners; Local, State or Central government authorities for the extraction, reconstitution and transportation of such materials to the relevant worksite.

2.14 ALIGNMENT & YARD PLANS ETC

2.14.1 The alignment plans, yard plans, building plans and power supply schemes and SCADA layouts listed in Bid Document Part 2, Section VII-3: Drawings and Documents are for reference purpose only.

2.14.2 The Contractor shall review, verify and revalidate all relevant factors which could have an impact on the Design and construction / Installation of 2X25 kV, 50 Hz, AC, Traction Electrification and associated works including but not limited to the topography, subsurface conditions, ground water levels, Temporary Works, dewatering, drainage, climatic conditions, the availability or lack of access, working space, storage, accommodation, restrictions imposed by the existing Indian Railways Tracks, the proximity of adjoining structures and roads, the local regulations regarding the obstruction of public highways and any other limitations imposed by the site and its surroundings, for the satisfactory completion of Works meeting with performance requirements in the stipulated time.

2.14.3 It will be presumed that Contractor has verified at his end and taken note of all effects of these constraints in his Design, construction / Installation operations to ensure on-time completion of the Works.

2.14.4 No claim by the Contractor on the grounds of lack of foresight or knowledge of the site conditions or any unknown parameters shall be considered.

2.15 UNITS OF MEASUREMENT

The Contract shall utilize the SI system of units.

2.16 CLIMATIC CONDITIONS

2.16.1 General

a) The project length, from Prithla – New Harsana Kalan section falls along *KMP Expressway*. The design should consider the lowest and highest temperatures witnessed in the section.

- During the summer months the temperature as high as 48°C temperatures has been recorded in the section with a high level of humidity.
- During the winter months the temperatures lowest of (-) 3°C during night has been recorded in the section.
- Torrential rains and high humidity accompany the monsoon are in late June to early September.
- The Contractor's design should meet the requirement of the highest ambient temperature of 50°C and lowest ambient temperature of (-) 5°C.

**Part-2, Section VII-1: Employer's Requirements - General Specifications (GS)- 2x25 kV AC
Traction Electrification and associated work**

- 2.16.2 The above information is indicative only. Notwithstanding the stipulation at (1) above, the contractor shall collect climatic data in respect of minimum & maximum temperatures, rain, flood levels, relative humidity, sun shine and wind velocity/pressure etc. from "India Meteorological Department publications" or other Civic Bodies and shall consider for designing any part/ component of the Permanent Works and in case the ambient temperature is beyond the range of 50°C and (-) 5°C, the Contractor shall ensure that due allowance is made for severe most local conditions in which Permanent Works are required to operate, for example, with restricted ventilation that may lead to higher local ambient temperatures, and any other factors that may affect the operating environment in any way.
- 2.16.3 The Contractor's attention is drawn to the more severe environmental conditions that may exist during the construction/ Installation period. The contractor shall take adequate measures to protect the Permanent Works against any deleterious effects of such conditions during the time between installation and final completion of the Project. The Contractor shall be deemed to have taken into account all weather conditions arising from any cause whatsoever, including river flooding, excessive rainfall, salinity, temperature, humidity, high winds, lightning, or any other weather conditions as per IS 13736 (all parts) and as per the application duty requirement.
- 2.16.4 Without limiting its liabilities under the Contract, the Contractor shall take all necessary precautions to protect the Works and Contractor's Equipment against the effects of weather, provided however Contractor shall inform the Engineer in such circumstances which lead to stoppage of works.

2.16.5 Classification of Equipment Environment

- a) Table below gives the different classifications of equipment environment to be encountered. The locations at which equipment may be installed have been divided into five environmental classes as mentioned below.

CLASS	LOCATION of EQUIPMENT
A	Air Conditioned Offices and Equipment Rooms. Air-conditioning failure of less than 2 hours duration at a time is permissible.
CLASS	LOCATION of EQUIPMENT
B1	Equipment Rooms with air-conditioning with possibility of failure of air-conditioning for a duration of 2 hours or more at a time.
B2	Equipment Rooms without air-conditioning where adequate ventilation may or may not be available.
C	Buried underground or installed in manholes.
D	Outdoors – Cabinets or Containers protected from direct sunlight without any ventilation.

- b) All equipment shall be designed and tested in accordance with the given figures in the Employer's Requirement. All designs for equipment shall work within the enclosures proposed with the specified environment outside the enclosure. The following are the minimum design requirements for equipment to be installed in each class of environment. Where any class does not have a value for a parameter the most extreme value quoted for the lesser class environments should be used. For any equipment that is proposed to be installed in more than one environmental clause, the design shall take into account the most severe environmental class conditions.

(a) Requirements for Class A

**Part-2, Section VII-1: Employer's Requirements - General Specifications (GS)- 2x25 kV AC
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Minimum Temperature	5°C
Ambient Temperature	29°C
Maximum Temperature	35°C
Relative Humidity	Minimum 0%, Nominal 65%, Maximum 95% (Non Condensing)
Electrical Noise	High Frequency to 1MHz. 1kV damped to 50% after 6 cycles. Radio Frequency field strength 10 V/m, UHF & VHF bands.

(b) Requirements for Class B	
Minimum Temperature	(-) 2.5°C (B1) and (B2)
Ambient Temperature	30°C (B1) and 50°C (B2)
Maximum Temperature	45°C (B1) and 55°C (B2)
Relative Humidity	Nominal 70%, Maximum 100% (Non condensing)
Air Quality	Polluted and dusty - SO ₂ :80-120mg/m ³ Suspended Particulate Matter: 360-540mg/m ³
Electrical Noise	Impulse 1kV, 1.2/50 rise/decay, 500Ω source impedance, 0.5J source energy.
Radio & High Frequency	as Class A.

(c) Requirements for Class C	
Minimum Temperature	(-) 2.5°C
Ambient Temperature	46°C
Maximum Temperature	60°C
Relative Humidity	Nominal 70%, Maximum 100% (Non condensing)
Electrical Noise	Impulse 5kV, otherwise as Class B

(d) Requirements for Class D	
Guaranteed Temperature Range	0°C to 55°C
Operational Temperature Range	(-) 5°C to 60°C

(End of Chapter 2)

CHAPTER 3 - PROJECT PLANNING & MANAGEMENT

3.1 GENERAL

3.1.1 In order to ensure compliance with the Requirement of Contract and satisfactory Programed execution of the works within specified targets, and quality in design, manufacturing and execution of work, a series of Management Plans shall be developed.

3.1.2 The Plans and Documents shall be coordinated with each other and shall collectively define, describe and encompass the Contractor's proposed methods, procedures, processes, organization, sequencing of activities, etc. and shall show how these combine together to assure that the Works truly meet the requirements of the Specification in respect of the mentioned subjects.

3.1.3 Unless otherwise stated in the PS, all plans and documents shall be submitted as detailed below :

- a) As required in accordance with the Works Program;
- b) whenever the development of the Contractor's designs or planning allows the plan to be developed further;
- c) in response to comments made by the Employer's Personnel/Engineer
- d) whenever any change occurs that invalidates the information contained in the previously submitted and reviewed document, within 28 days of the occurrence of such change; and
- e) as requested by the Engineer from time to time

3.1.4 The following Management Plans shall be developed and submitted by the Contractor for the Engineer's review.

Sr.	Management Plan/ Submission	Submission
1	Project Management Plan	42 days
2	Mobilization Plan / Project Organization Plan	28 days
3	Document Management Plan	28 days
4	Design Management Plan	28 days
5	Design Submission Plan	28 days
6	Simulation Study Plan	56 days
7	Interface Management Plan	42 days
8	System Assurance Plan	56 days
9	Quality Assurance and Management Plan	56 days
10	Reliability, Availability, Maintainability and Safety (RAMS) plan.	90 days
11	EMC/EMI Management Plan	42 days
12	Software Quality and Assurance Plan	42 days
13	Fire Safety Plan	42 days
14	Verifications, Validation and Demonstration Plan.	90 days
15	Procurement Management & Manufacturing Plan	56 days
16	Factory Acceptance Test Plan	180 days
17	Installation Plan	90 days

**Part-2, Section VII-1: Employer's Requirements - General Specifications (GS)- 2x25 kV AC
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18	Site Management Plan	42 days
19	Site Safety Plan	<i>As mentioned in ESHS Manual</i>
20	<i>Deleted</i>	-
21	Testing & Commissioning Management Plan including Trials and Integrated testing & commissioning	180 days
22	Permits and Approvals plan	90 days prior to date of Taking over of Completed works.
23	Training Plan	90 days. Prior to the commencement of the First Training Session of the course
24	Operation & Maintenance Plan and Spares Management	180 days prior to date of Taking over of Completed works.
25	Defect Liability & Notification Plan	180 days prior to date of Taking over of Completed works.

3.1.5 These plans shall be further developed / modified / magnified in accordance with the procedure described in this General Specification during the course of the Project as required.

3.1.6 The respective Plans shall be submitted which shall have received 'No Objection' from Engineer who shall have the right to request the Contractor to make amendments as deemed necessary.

3.2 PROJECT MANAGEMENT PLAN

3.2.1 The overall management of the Works shall be the Contractor's responsibility. The organization of the resources for the design, procurement, manufacture, delivery, installation, testing and commissioning, and setting to work is to be clearly defined & developed into a Project Management Plan. Each section of this plan shall fully describe the Contractor's understanding of the Works and management skills and structure required to achieve the same.

3.2.2 The Contractor shall nominate suitably qualified and experienced English-speaking engineers from his staff to be Project Manager, Deputy Project Manager(s), Senior Engineers and other Key personnel as specified in Part-2. The nominee(s) shall be subject to acceptance of the Engineer, who shall have the right to demand his/their replacement at any time after the work commences, should the Engineer consider this to be in the best interest of the Project.

3.2.3 The Project Manager(s) shall be mobilized on full time basis for execution of work at site, within 28 days from the Commencement Date and shall continue up to the end of Defects Notification Period. The contractor shall establish & maintain the required Project management / Site office(s) at location(s) as approved by the Engineer and shall be retained to meet the contract Obligations until the completion of the Defect Notification Period.

3.2.4 The Contractor shall nominate dedicated senior engineers to co-ordinate activities of :

- (1) The design offices responsible for designing;
- (2) Procurement and manufacturing works;
- (3) Construction / Installation;
- (4) Testing & Commissioning;
- (5) Other activities as required

3.2.5 The Project management plan shall define the Contractor's management structure for the execution of the Works and for the control of the quality of the Works and shall, without limitation, identify and set out:

- a) The procedure for audit;
- b) The procedures for the control of receipt and issue of all Works related correspondence so as to ensure traceability;
- c) The procedures for filing system to be implemented to maintain the Contractor's records during the course of the work. The filing systems used by the Contractor and sub-contractors of any tier shall be compatible;
- d) The procedures for the identification, production, verification, internal approval, review (when required) by the Engineer, distribution, implementation and recording of changes to all drawings, reports and specifications;
- e) The procedures for the evaluation, selection, engagement and monitoring of sub-contractors / suppliers together with the means of application of quality assurance to their work including audit and acceptance;
- f) The procedure for the regular review and revision of each type of quality plan and its supplemental individual specific quality plans to ensure their continuing suitability and effectiveness, in addition to the method to be used for revision and issue of revised documentation;
- g) The procedures for the control, calibration and maintenance of inspection, testing and measuring equipment;
- h) The procedures for the selection, indexing, disposition and maintenance of project records for storage in the archives. A list of items to be archived including their periods of retention shall be submitted for review by the Engineer;
- i) The procedures for identifying training needs and for the provision of training of all personnel performing activities affecting quality; and
- j) The procedures for the control of non-conformity.

3.2.6 The Project Management Plan submitted by the Contractor shall be reviewed by the Engineer, who will have the right to seek amendments as deemed necessary by the Engineer

3.2.7 Contractor's Personnel

- a) The Contractor shall provide all necessary supervision during the execution of the Works as long as the Engineer considers necessary for the proper fulfilment of the Contractor's obligations under the Contract.
- b) The Contractor shall ensure that he is at all times represented on the Site by a competent and authorised English/Hindi speaking Personnel who shall be deemed to have been reviewed without objection by the Engineer, in writing within 14 days from the service of a notice upon the Engineer by the Contractor for the appointment of such Personnel. Such Contractor's personnel shall be constantly on the Site and shall give his full time to the superintendence of

the Works.

- c) The Engineer shall have the authority to withdraw his notice of no objection to the Contractor's Personnel at any time. If such notice of no objection is withdrawn, the Contractor shall remove the Contractor's Personnel from the Site forthwith and shall not thereafter employ him again on the Site in any capacity and shall forthwith replace him by another competent English/Hindi speaking Contractor's Personnel as 'reviewed without objection' by the Engineer.
- d) Such authorised Contractor's Personnel shall receive on behalf of the Contractor directions and instructions from the Engineer.
- e) The following particulars of the proposed Contractor's Personnel shall be submitted to the Engineer for review:-
 - (i) name;
 - (ii) copy of Identity Card;
 - (iii) details of qualifications, including copies of certificates; and
 - (iv) details of previous experience.
- f) The particulars of the Contractor's Personnel shall be submitted 28 days before the agreed 'scheduled start' of that part of the Works, except in the case of a replacement of Contractor's Personnel, in which case, the said particulars shall be submitted forthwith.

3.3 MOBILIZATION PLAN

- 3.3.1 The Contractor shall within 28 days from the Commencement Date submit a mobilization Plan for the Engineer's review.
- 3.3.2 The Mobilization Plan shall include but not be limited to Setting up of Design Office, Site office, mobilization of Contractor's Key and support personnel, Procurement of facilities, Information required by the Contractor and deliverables to be submitted.
- 3.3.3 Manpower forecasts shall be prepared in the form of a series of graphic displays based on the Works Program resource-loading. The output shall display the number of man-days of effort, for each month over the life of the Project on both 'early start' and 'late start' basis.
- 3.3.4 Within 7 Days of receiving the Letter of Acceptance (LOA) of the work, Contractor shall set up the required communication facilities i.e. office Telephone, fax and documentation facility immediately.
- 3.3.5 Within 15 days of receiving the LOA of the work, the Contractor shall issue a communication matrix identifying the Project Manager and the other key personnel with their roles and responsibilities and their communication telephone, mobile, fax and email addresses and shall keep it updated throughout the project.

3.4 DOCUMENT MANAGEMENT PLAN

The contractor shall establish a Document Management System as detailed in Chapter-5: Document Management of this GS. Document Management Plan shall incorporate the Document Control Procedures such as:

- a. Document Format;
- b. Document numbering system;

- c. Document release / version control;
- d. Obsolete/ superseded Document withdraw system;
- e. Number of copies.

3.5 DESIGN MANAGEMENT PLAN

3.5.1 Design shall be undertaken to ensure a smooth flow of information for review by the Engineer. Submissions shall be strictly in accordance with the Design Submissions Program.

3.5.2 The Contractor shall perform his designs for the Works and prepare a design plan for his design work in accordance with the following design stages. The Contractor shall submit to the Engineer for his review, relevant design information as identified under each stage:

- a. Preliminary Design along with Performance parameters and design verification checklists, design Manual;
- b. Detailed Design;
- c. Construction / Installation Design & drawings;
- d. As Built Documents.

3.5.3 The Contractor shall submit a Design Management Plan detailing the design process and describing:

- a. The "Design Input" for the project;
- b. The organization chart for the design team;
- c. The process for integration of all the systems;
- d. The process for internal design review and signing of drawings and design documentation (by officials with name i.e. prepared by, checked by and issued by) prior to submission for review by the Engineer;
- e. The design Submission Program;
- f. The process for design change control.

3.6 DESIGN SUBMISSION PLAN

3.6.1 The objective of the design submission plan is to ensure that the proposed resulting works comply with the Employer's Requirements and the Standards and Specification, are capable of being produced consistently to exacting quality standards, achieve low life cycle costs and can be operated with high reliability and safety to the satisfaction of the Engineer.

3.6.2 The design submissions include design calculations, design reports and design drawings.

3.6.3 In the event that a statutory body (e.g. Government of India Ministry of Railways, RDSO, Commissioner of Railway Safety, etc.), Independent Engineer, independent RAMS assessor or independent safety assessor requires design information in a particular format or any other additional information, it shall be incumbent upon the Contractor to provide the same, as directed by the Engineer.

3.7 SIMULATION STUDY PLAN

- 3.7.1 The Contractor shall identify the simulation study requirements as specified in Particular Specification and submit a Simulation Study Plan identifying:
- a) the Activities and deliverables of simulation study;
 - b) Identification of the proven simulation agency;
 - c) Approval of the Engineer / Employer's Personnel and engagement thereof of the Simulating Agency;
 - d) Submission of Input Data Reports;
 - e) Review of the Input Data Report by the Engineer;
 - f) Incorporation of the observations of the Engineer;
 - g) Producing Simulation and Simulation results for various options;
 - h) Review of The Simulation Results by the Engineer/ Employer's Personnel;
 - i) Incorporation of the observations of Engineer/ Employer's Personnel on Simulation Results;
 - j) Conducting revised Simulation and Producing Simulation results for various options;
 - k) The Simulation Results shall conform and validated to Standards EN 50119, EN50317, EN50318, EN50329, EN50388, EN50367, EN50641, EN50163, EN50122-1, EN50124-1 , EN50121 (all Parts), IEEE80:2013, IEC 60909 and other standards as specified in Part 2-Employer's requirement.
- 3.7.2 The simulation study may involve a number of iterations to optimize the Solution.
- 3.7.3 Simulation study shall suggest a value added optimized solution with reasoning.
- 3.7.4 The Scope of Simulation Study is included in Particular Specification.

3.8 INTERFACE MANAGEMENT PLAN

- 3.8.1 The Contractor shall interface and liaise with Other Contractors in accordance with the Employer's Requirements, Chapter-10 – Interface Management Plan of this GS and in relevant chapter of Part – 2, section VII – – 2 : Particular specifications.
- 3.8.2 The Contractor shall develop and submit to the Engineer, an Interface Management Plan, which is mutually acceptable to both the Contractors and the Other Contractors. The Interface Management Plan shall:
- a) identify the sub-systems as well as the civil works and facilities with interfacing requirements;
 - b) define the authority and responsibility of the Contractor's and Other Contractors' (and any relevant sub-contractors') staff involved in interface management and development;
 - c) Identify the information to be exchanged, precise division of responsibility between the Contractor and Other Contractors and integrated tests to be performed at each phase of the Contractor's and Other Contractors' works;
 - d) Address the Works Program of the Contract to meet dates of activities of each Contractor and highlight any program risks requiring attention of the Employer.

- 3.8.3 The Engineer shall review the Contractor's initial Interface Management Plan and shall

have the right to require the Contractor to make amendments as deemed necessary by the Engineer. The Contractor shall amend the initial Interface Management Plan based on the comments received from the Engineer and submit the final Interface Management Plan and the Engineer shall issue an Advice of No Objection to such Interface Management Plan.

3.8.4 The Contractor shall be responsible for detailed co-ordination of his design, manufacturing, construction/installation, testing and commissioning activities and will take the lead for System Works in the management of the coordination process with IR, interfacing contractors, utility agencies, statutory authorities, private service providers, consultants and other contractors whether or not specifically mentioned in the contract that may be working on or adjacent to the site for the purpose of the Project.

3.8.5 System Work Contractor, Electrical shall plan his interfacing requirements accordingly.

3.9 SYSTEM ASSURANCE PLAN

The Contractor shall submit, the System Assurance Plan for approval of the Engineer as described in the RAMS Chapter-12 of this GS.

3.10 QUALITY ASSURANCE AND MANAGEMENT PLAN

The Contractor shall submit the Quality assurance and Management for approval of the Engineer as described in Chapter -11 of this GS.

3.11 RELIABILITY, AVAILABILITY, MAINTAINABILITY & SAFETY (RAMS) PLAN.

3.11.1 The Contractor shall submit a RAMS Plan for approval of the Engineer as described in the RAMS chapter-12 of this GS and relevant chapter in PS.

3.11.2 The Contractor shall describe procedures required to perform the specific tasks necessary to achieve RAMS requirements in this plan including the RAMS demonstration Plan.

3.12 EMC/EMI MANAGEMENT PLAN

3.12.1 The Contractor shall prepare and submit for review by the Engineer, an EMC Plan in accordance with the Employer's Requirements. The Contractor shall describe procedures required to perform the specific tasks necessary to achieve EMC requirements.

3.12.2 EMC/EMI Management Plan should be based on a top-down approach defining the EMI, EMC philosophy, Assessment & Control activities, means of control during design processes and implementation and EMC submissions to be supplied to demonstrate compliance with Employer's Requirements: General Specification and Particular Specification. The EMC/EMI Management Plan shall identify a comprehensive list of specifications, standards, method statements and procedures to be submitted to the Employer's Personnel / the Engineer for review. The EMC Management Plan shall also include a Program for the dates for EMC submissions.

3.12.3 The EMC/EMI Management Plan shall include an initial list of design documentation, test specifications and test reports with a single paragraph description of each document to indicate compliance with the Specification.

3.12.4 The EMC/EMI Management Plan shall include a definition and description of the process

and methods used for Verification and Validation that the Works will achieve the required EMC parameters in all respects.

- 3.12.5 The Contractor shall assess and control the levels of interference emissions and susceptibility of all equipment which are to be designed, manufactured, supplied and installed by the Contractor and its sub-contractors and suppliers.
- 3.12.6 The Contractor shall designate a person as point of contact to deal with EMC matters. Details of the nominated person and any subsequent change of the nominated person shall be subject to review by the Employer's Personnel/ The engineer.
- 3.12.7 The Contractor shall liaise and co-ordinate with all Other Contractors in the exchange of EMC data and related equipment performance characteristics and advise the Engineer when any such information is requested from any Other Contractor. A copy of all EMC related information exchange shall be sent to the Engineer for review.
- 3.12.8 The Contractor shall comply with the following EMC requirements:
- a) The Contractor shall ensure that all electrical and electronic apparatus is designed and constructed to operate without degradation of quality, performance or loss of function in the electromagnetic environment of the Project.
 - b) The Contractor shall meet the requirements of the BS EN 50121 series of standards (Railway applications – Electromagnetic compatibility), 1996 edition, the UK's Electromagnetic Compatibility Regulation, the IEC 61000: Electromagnetic Compatibility or equivalent and other standards mentioned in the Employer's Requirements-Particular Specification. EMC considerations shall be incorporated in the Contractor's procedures for product safety and design Verification.
 - c) The design shall ensure that any electromagnetic interference emissions introduced into the environment do not exceed the limits as prescribed in Standards. The Contractor shall ensure that electromagnetic compatibility (EMC) requirements are adequately complied. Any shortcomings shall be made known to the Engineer immediately and recommendations for corrective action formulated.
 - d) In respect of the design documentation, the Contractor shall demonstrate by theoretical analysis that the design of the electrical and electronic systems is fully compliant with the EMC requirements identified. The Contractor shall state clearly in the documentation all the assumptions made and parameters used in the analysis.
 - e) The Contractor shall detail the methodology, verify and validate any simulation models used in support of the analysis. The Contractor shall prepare and submit to the Engineer for review reports of the Verification and Validation of the models.
 - f) The Contractor shall submit documentation/ evidence showing how system safety and reliability is not affected with achieved EMC. It shall include Failure Modes, system failures, and the effect of human intervention and how equipment EMC thresholds have been set in order to keep them above worst case interference levels, and how equipment tolerances and other characteristics in the Specification have been allowed for in designing the system.
 - g) The Engineer may conduct an independent EMC audit for both the system and its component parts and shall therefore require access to all the relevant design and production information. The Contractor shall supply sufficient documentation and analysis in a form reviewed by the Engineer.
 - h) EMC type testing as per standards shall be carried out on all equipment identified in the design stage, which require attention regarding EMC.

- i) The Employer's Personnel/ the Engineer may request at his discretion, attendance at the manufacturing factory prior to delivery to assist in providing confidence that the EMC requirements will be met. However, this will not give design acceptance that can only be given after successful completion of the System Acceptance Tests.
- j) The Employer's Personnel/ the Engineer may request that tests be carried out to simulate the Failure Mode of any critical hardware/software component that is considered to have a significantly detrimental effect.
- k) The Contractor shall implement corrective actions to rectify any EMC problems identified during design, on-Site testing and when the whole system is in operational service.

3.12.9 The Contractor must be fully aware of the EMC requirements and any modifications to systems and equipment carried out by the Contractor during the Defect Notification Period shall not cause the immunity or emission levels of the installed system and equipment to exceed such values. Detailed EMC documentation on all modifications carried out shall be submitted to the Engineers for review. Modification work shall not commence until the respective submission has been reviewed without objection by the Engineer.

3.13 SOFTWARE QUALITY AND ASSURANCE PLAN

Where software is design Deliverable, the Contractor shall submit the Software Quality Assurance Plan for approval of the Engineer as described in RAMS Chapter-12 of this GS. The Software quality Assurance plan shall address all elements of the design and development of the software required as part of the works.

3.14 FIRE SAFETY PLAN

The contractor shall conduct a Risk and hazards study to identify the fire hazards for each system / sub-system /components. Such study shall include but not be limited to I Power supply installations and short circuit faults on OHE system assess the fire load, the Fire size (height & volume and gradients) and find out the Mitigation measures at Substations and Switching Stations. The Contractor shall develop a Fire safety Plan in compliance of NFPA – 130.

3.15 VERIFICATION, VALIDATION AND DEMONSTRATION (VVD) PLAN

3.15.1 The contractor shall prepare a Verification, Validation and Demonstration plan to validate and demonstrate system performance and reliability.

3.15.2 The Design Verification and Validation (DVV) plan, supplementary to design Management plan shall be prepared by the Contractor in order that design Verification and validation activities are properly directed. The plan shall address, but not be limited to, the following:-

- a) the objectives of each Verification phase and each Validation phase;
- b) defined input and output criteria for each development phase;
- c) identification of types and detailed methods of test, Verification and Validation activities to be carried out;
- d) detailed planning of Verification and Validation activities to be carried out, including schedules, resources and approval authorities;
- e) selection and utilisation of the test equipment, and their test environmental

- conditions; and
- f) criteria on which the Verification or Validation is judged to be acceptable. These criteria shall be traceable to the design and performance requirements.
- 3.15.3 The Performance Deliverables for each system/ subsystem/ component as applicable and as identified in Particular specification shall be got verified and validated by the Contractor. The Contractor shall prepare a Design Verification Table (DVT) that identifies the contractor's proposed methodology for demonstrating compliance.
- 3.15.4 The DVT shall be supplied to the Engineer for his review and shall be monitored throughout the design and construction of the works. Changes, if any, to the DVT, must be submitted to the Engineer for approval before implementation.
- 3.15.5 The DVT shall identify the proposed Verification and Validation process (es) for each specification requirement and the acceptance criteria for achieving the requirement. The DVT does not relieve the contractor of any other requirements of the Specifications in relation to design review, Verification, Validation, conformance or planning.
- 3.15.6 For each item in the DVT, the Verification and Validation methods to be used shall be listed by the Contractor. The methods used shall be reviewed by the Engineer.
- 3.15.7 Subject to review without objection by the Engineer for each application, the Verification and Validation methods listed below are acceptable if implemented (whether singly or in combination):
- a) Similarity – equipment and requirement are identical to those successfully applied on other projects.
 - b) Historical – requirement has been met by numerous previous design.
 - c) Calculations and Drawings – for review.
 - d) Design Review – either scheduled or specifically targeted.
 - e) Development Test – performance testing on equipment or material under development.
 - f) Type Test – performance testing of the as-built component, assembly or system.
 - g) Routine Test – test every component, assembly or system.
 - h) First Article Inspection (FAI) – acceptances of the exact look and fit of equipment.
 - i) Inspection – formal inspection of the finished item.
 - j) In Service – for service demonstration requirements only.
- 3.15.8 After each Verification or Validation activity, a Verification Report shall be produced including, as a minimum, the following:
- a) The Verification or Validation results stating whether the objectives and criteria of the Design Verification and Validation Plan have been met; and
 - b) The reasons for failure if there is a failure, and proposal for remedial actions.
- 3.15.9 The Results of Verifications and Validations shall be demonstrated to the Engineer with evidence of records and tests.
- 3.15.10 Verification and Validation (V&V) shall include the demonstrations as required for the RAMS.

3.16 PROCUREMENT MANAGEMENT & MANUFACTURING PLAN

3.16.1 The Contractor shall prepare & submit for review by the Engineer, a Procurement Management & Manufacturing Plan comprising of the details on Procurement, Manufacturing and Delivery Plan in respect of all items and goods. Separate parts of the plan shall also be prepared by the Contractor, his suppliers and subcontractors for their off-site activities. Each plan shall identify the scope of work to be applied. In relation to such scope of work, it shall, without limitation, define:

- a) the organisation of the Contractor's personnel directly responsible for the day-to-day management of the manufacturing activity on or off the Site;
- b) the specific allocations of responsibility and authority given to identified personnel for the day-to-day management of the work with particular reference to the supervision, inspection and testing of the work;
- c) the interfacing or co-ordination required with the Contractor's other related plans;
- d) a full list of manufacturing method statements for major components, equipment and/or systems to identify the specific methods of manufacture;
- e) The format of the Material Control Schedule to monitor and control the production, manufacturing and delivery, for the Contractor, sub-contractors of any tier, suppliers and sub-suppliers;
- f) the list of procedures and work instructions to manage and control the quality of work during purchasing, manufacturing and delivery, including without limitation:
 - a. the purchasing of items and goods and ensuring they comply with the requirements of the Specification, including (without limit) purchasing documentation and specific Verification arrangements for Contractor/the Engineer, inspection of material or manufactured product prior to release for use;
 - b. the manufacturing process so as to ensure compliance with the design;
 - c. the manufacturing process so as to ensure clear identification and traceability of material and manufactured parts;
 - d. the inspection & testing of inward materials/in process & final product to ensure specified requirements for the material and/or manufactured product are met;
 - e. the identification of the inspection and test status of all material and manufactured products during all stages of the manufacturing process to ensure that only products that have passed the required inspections and tests are dispatched for use and/or installation;
 - f. review and disposal of non-conforming material or product so as to avoid unintended use;
 - e. the assessment and disposal of non-conforming material and manufactured product and approval for reworking or rejection as scrap;
 - f. the identification of preventive action so as to prevent recurrence of similar non-conformance; and
 - g. the handling, storage, packaging, preservation & delivery of manufactured product.

3.16.2 The Contractor shall prepare and submit the inspection and testing plans to manage and control any test and inspection activities.

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- 3.16.3 The Contractor shall propose a structured set of inspection hold points. The hold points shall be structured such that a formal hold point is allowed for each significant element of the manufacturing process. At each hold point, the Employer's Personnel/ the Engineer shall hold a formal inspection or advise that the inspection has been waived.
- 3.16.4 Once the inspection and any required remedial actions are completed to the satisfaction of the Engineer, the Engineer may give a notice of no objection to the results of Inspection as jointly witnessed. The Engineer will not withhold his notice of no objection for shipping unreasonably, provided all pre-delivery assembly and testing has been successfully completed.
- 3.16.5 The Material delivery plan shall cover each and every part of the delivery of all items and goods from the manufacturing premises to the Site. The delivery plan shall cover all lifting and handling activities and the steps to be taken to protect all items and goods from damage during each segment of the journey. The arrangements for customs clearances, inspections, highways permits etc. shall also be fully described.
- 3.16.6 The Material control schedule shall be automated, and shall detail the following information for each permanent major and minor material and significant component. The format of such a schedule shall include:
- a. Activity reference
 - b. Name, description of item/ activity;
 - c. Supplier/sub-supplier details;
 - d. Time required for manufacture/ construction;
 - e. Drawing information (where appropriate), title, drawing status, submission dates, shop drawings/ fabrication drawing preparation, etc.;
 - f. Manufacturing process, manufacturing of test pieces, trial production, the Engineer inspection, monthly production of components and monthly supply of components;
 - g. Assembly process, erection and assembly sequences (particularly for the first pieces) prior to shipment, test assemblies, monthly assembly requirement the Engineer inspection, testing of assemblies; and
 - h. Purchase order date; and
 - i. Transportation process, quality release from factory, factory storage, transport to dock, shipment.
- 3.16.7 The Schedule shall also be updated for:
- a. Factory Acceptance Test (FAT) Date
 - b. Scheduled Shipping Date.
 - c. Scheduled Job Site Arrival Date.
 - d. Shipping Method Air/Ocean Classified/Unclassified.
 - e. Actual Shipping Date.
 - f. Actual Arrival date.
 - g. Quantity Actually Received.
- 3.16.8 The schedule shall tie materials tracking to the respective work activity.
- 3.16.9 The Contractor shall continuously update this schedule and report upon the status of

each item as part of the Contractor's regular progress reporting. From this base data, the Contractor shall prepare an exception report detailing all components that are in delay. This report shall be annotated with the reason for the delay and shall indicate what action the Contractor is taking to recover the lost time.

3.16.10 Manufacturing Submissions

The Contractor shall identify the specific methods of manufacture for major components, equipment and systems in the manufacturing method statements and develop those method statements to a degree of sufficient detail to be reviewed by the Engineer. All manufacturing method statements shall be submitted for review by the Engineer 56 days prior to the commencement of the respective manufacturing activities.

The Contractor shall prepare and maintain a full list of all the manufacturing method statements required for the Contract with submission status and review status, and shall submit to the Engineer upon request. The manufacturing method statement shall include, but not be limited to, the following:

- a. the particulars of the materials to be incorporated into the items;
- b. the manufacturing process flowcharts in compliance with drawings and specification;
- c. the identification or referencing requirements for traceability of the manufacturing products;
- d. the identification of inspection and test check points and status of materials and final manufactured products; and
- e. The handling, storage, packing, preservation and delivery of the manufacturing products.

3.17 FACTORY ACCEPTANCE TEST PLAN

3.17.1 The Contractor shall prepare and submit for review by the Engineer the Contractor's Factory Acceptance Test Plan detailing and explaining how the Contractor will plan, perform, and document all inspections and tests that will be conducted to verify and validate the Works prior to delivery to the Site. The plan shall consist of a narrative description supported by graphics, diagrams and tabulations as required.

3.17.2 The plan shall contain but not be limited to the following topics:

- (1) The Contractor's strategy for inspection and Factory Acceptance Tests of all constituent parts of the Works and how this relates to the sequence of delivery and Procurement Management & Manufacturing Plan;
- (2) The sequencing and interrelationships of the inspections and tests including all Quality Hold Points and Quality Control Points;
- (3) The type and extent of inspection and Factory Acceptance Tests to be undertaken and the parts of the Works to be proven by that testing;
- (4) The objective of each inspection or test, what particular design and operating criteria the test or inspection will prove and how the success of the test or inspection will be demonstrated or measured;
- (5) Organisation Chart of test team and CV of key personnel in inspection;
- (6) The plan for the production and submission of the inspection and test procedures to the Engineer for review including the submission of the inspection and test reports and records; and

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- (7) Type Tests/Routine Tests/First Article Inspections and any other tests constituting the Factory Acceptance Tests.
- 3.17.3 This plan shall clearly demonstrate the logic of all related processes the logical dependencies between the individual tests of the Works, and shall also show the interfaces and dependencies with the Contractor's delivery program. The Factory acceptance Tests shall be carried out in OEM's Premises/ factory / Manufacturing place.
- 3.17.4 Factory acceptance Tests shall include Type/Routine/ acceptance/ special Tests at Original Equipment Manufacturer (OEM) factory or the Accredited Test lab / test house as approved by the Engineer". Routine tests shall include tests such as visual inspection, dimension check, electrical conductivity check, insulation check, calibration, mechanical and hydraulic tests and any other compliance tests etc. as per specification. Type tests shall be performed on a sample of the complete equipment of each type and rating etc. based on SOGP and agreed standards or specification. The FAT stage may also include some integration tests at the manufacturer's factory, which are performed to test the integration of the components that make equipment. Each software system (such as the SCADA system) shall be tested to simulate inputs and outputs including integration testing as possible, thereby reducing the overall integration risks to equipment at later stages. Each software FAT should take place in an environment as close as possible to the operational environment or suitably de-rated for application duty requirement.
- 3.17.5 The FAT Plan shall include a comprehensive list of the tests, Tests to be witnessed by representatives of various parties i.e. the Contractors' representatives, the Engineer or his representative, the duration of the test, Tentative dates, and minimum of 28 days prior notice period to all representatives to witness the test.
- 3.17.6 The FAT Plan shall include details of inspection, testing and witnessing of the Contractor's and subcontractor's procurement and manufacturing activities at OEM's Factory. As a minimum, it shall include:
- a. First Article Inspection;
 - b. Quality Hold Points;
 - c. Type Tests; and
 - d. Routine tests.
- 3.17.7 The Contractor shall arrange for all equipment and systems manufactured for incorporation into the Permanent Works to undergo a Factory Acceptance Test (FAT) before shipment from the place of manufacture.
- 3.17.8 The Contractor shall be responsible for re-inspecting and re-testing any failed inspection and Factory Acceptance Test including regression testing on previously passed items.
- 3.17.9 Inspections and tests that are to be witnessed by the Employer's Personnel /the Engineer shall be sensibly grouped and scheduled so that as many inspections and tests as possible may be witnessed during a single visit.
- 3.17.10 The Contractor shall prepare two copies of an inspection or test report immediately after the completion of each inspection or test whether or not witnessed by the Employer or the Employer's Personnel/ the Engineer. If the Employer's Personnel /the Engineer has witnessed the inspection or test, he may countersign the inspection or test (i.e. whether or not the equipment being inspected or tested has passed satisfactorily) contained therein. If the Employer's Personnel /the Engineer has not witnessed the inspection or test (i.e. if a waiver has been granted, or for some other reason in accordance with the Contract), the Contractor shall forward two copies of the inspection or test report without delay to the Engineer. In case the results of the inspection or test do not meet the

requirements of the Specification, the Employer/ the Employer's Personnel/ the Engineer may call for a re-inspection or re-test.

- 3.17.11 For standard equipment which is serial or bulk manufactured, manufacturer's type test certificates (or equivalent) may be acceptable, subject to review by the Engineer.
- 3.17.12 Test equipment and instrumentation shall be subject to approved calibration tests within a properly controlled calibration scheme, and signed calibration certificates shall be supplied to the Engineer in duplicate. Such calibration checks shall be undertaken prior to testing and, if required by the Employer's Personnel/ the Engineer, shall be repeated afterwards.
- 3.17.13 Materials and equipment shall not be released for shipment until all applicable inspections and tests including Factory Acceptance Tests have been satisfactorily completed.

3.18 INSTALLATION PLAN

- 3.18.1 The Contractor shall prepare and submit Installation Plan for the Engineer's approval.
- 3.18.2 The Plan shall be configured as a family of "stand-alone" plans and associated documents for each System and subsystems as required.
- 3.18.3 The plans shall be coordinated with each other and shall collectively define, describe and encompass the Contractor's proposed methods, procedures, processes, organization, sequencing of activities, etc. and shall show how these combine together to assure that the Works truly meet the requirements of the Specification in respect of the subjects listed.
- 3.18.4 The Contractor shall prepare plans for the construction & installation activities on and off the site, and shall ensure that these are properly related to the subsequent testing and commissioning activity. Separate parts of the plan shall be prepared for other contractor(s) or sub-contractor(s) off-site activities.
- 3.18.5 Where all or part of the works is within the HORC Protection Zone, the contractor shall follow the guide lines issued by the Employer's appropriate authority. The Contractor shall submit to the Engineer for review, his construction method statement and detailed design of any Temporary Works proposed to be erected within this zone adjacent to IR/DFCCIL properties.
- 3.18.6 The plan shall, without limitation, describe:
- a) The organisation of the Contractor's staff directly responsible for the day-to-day management of the activity on or off the Site;
 - b) The specific allocations of responsibility and authority given to identified personnel for the day-to-day management of the Works with particular reference to the supervision, inspection and testing of the Works;
 - c) the interfacing or co-ordination required with the Contractor's other related plans;
 - d) the specific methods of construction and installation to identify any relevant method statements and develop those method statements to a sufficient degree of detail reviewed by the Engineer;
 - e) A detailed method statement which shall include but not be limited to:
 - a. Description of main operations and sub-operations;
 - b. Sequence of sub-operations;
 - c. Quantities of the work and production rates to be achieved;

- d. Resources to be employed; and
- e. Quality checks to be carried out, supervision being exercised and safety precautions to be employed;
- f) the list of procedures and work instructions to manage and control the quality of construction and installation works, including without limitation:
 - a. The inspection and testing activities of incoming materials, in process and final product so as to ensure specified requirements for the material and/or product are met;
 - b. The procurement of materials and ensuring they comply with the requirements of the Specification, including purchasing documentation and specific Verification arrangements for Contractor/Employer's Personnel / the Engineer inspection of material or manufactured product prior to release for use/installation;
 - c. The construction processes including Temporary Works so as to ensure compliance with drawings and Specification. In addition, any software to be used in the construction, installation and commissioning process shall be identified and details of the Verification and Validation processes for the software application shall be given;
 - d. The construction and installation process so as to ensure clear identification and traceability of material and manufactured product;
 - e. The identification of the inspection and test status of all material and manufactured products during all stages of the construction and installation process to ensure that only products that have passed the required inspections and tests are dispatched for use and/or installation;
 - f. The assessment and disposition of non-conforming material and product and approval for reworking or rejection as scrap;
 - g. The identification of preventive action so as to prevent recurrence of similar non-conformance; and
 - h. The handling, storage, packaging, preservation and delivery of product; and
 - i. The security control of the Site and the works area for Contractor's accommodation, storage, car park and other works facilities, etc.

3.18.7 The following particulars shall be submitted to the Engineer for review within 28 days of the Commencement of any Construction activity at site:

- (i) drawings showing the layout within the Site of the Engineer's and Contractor's accommodation, Project signboards, access roads and major facilities required;
- (ii) Construction Reference Drawings, Shop drawings etc.

3.18.8 Drawings showing the location of stores, storage areas, work areas and other major facilities shall be submitted to the Engineer for review as early as possible, but in any case, not later than 28 days before commencement of construction of the facilities.

3.19 SITE MANAGEMENT PLAN

3.19.1 The Contractor shall submit Site Management Plan describing access, security, material storage, handing over and taking over of assets as per the requirement:

3.19.2 Access to Site

The Contractor will be given access to the Site in accordance with the Contract. Contractor shall manage the execution within allocated Right of Way (ROW). The Contractor shall coordinate with CST contractors for the same.

3.20 ESHS PLAN

The Contractor shall *prepare and submit the site ESHS plan in accordance with Part 2-Employer's Requirements, Section VII-4 ESHS Manual.*

- (1) The Contractor shall submit, as part of his *ESHS* Plan, a Site Management Plan, and also designate a *Safety Expert* who shall be a person properly qualified to ensure the safety at construction sites.
- (2) The Contractor shall be fully responsible for the safety of the Works, his personnel, his sub-contractors' personnel, the public, and any persons directly or indirectly associated with the Works, or on or in the vicinity of the Site. The Contractor shall treat safety measures as high priorities in all his activities throughout the execution of the work.
- (3) The Contractor shall submit to the Engineer, regular Site *ESHS* Reports, and shall notify immediately the occurrence of an accident involving his staff or that of his sub-Contractors, or to any person within the area of the Site for which the Contractor is responsible.

3.21 Deleted

3.22 TESTING & COMMISSIONING MANAGEMENT PLAN INCLUDING TRIALS AND INTEGRATED TESTING & COMMISSIONING

3.22.1 The Contractor shall submit a Testing and Commissioning Management Plan in accordance with this Employer's Requirements.

3.22.2 The plan shall describe the testing & commissioning strategy to be followed for the project at different stages and shall include but not limited to

- a) Factory Acceptance Test (FAT),
- b) Site Installation Test (SIT) / Standalone Testing,
- c) Site Acceptance Test (SAT),
- d) Integrated System Testing,
- e) Trial Runs & Commissioning.

3.23 TRAINING PLAN

The Contractor shall prepare and submit a Training Plan in a format and to a level of detail for review without objection by the Engineer. It shall be in accordance with Employer's Requirement.

3.24 OPERATION & MAINTENANCE PLAN

3.24.1 The Contractor shall prepare and submit for review by the Engineer an Operation & Maintenance Plan. The Plan shall include all the aspects related with the Monitoring, control & operation of the system / subsystem/ equipment and Maintenance thereof.

3.24.2 The Contractor shall develop an Operation & Maintenance Plan to suit staged commissioning of the system (if required) and to ensure the timely preparation of the Contractor's Operation and Maintenance Manuals and the 'As-Built' drawings in a format and to a level of detail reviewed without objection by the Engineer.

3.24.3 The Maintenance Plan & Maintenance Philosophy shall include the following:

- a) Proposed periodicity for each type of examination, inspection or overhaul,
- b) List of tasks to be carried out at each examination, inspection or overhaul,
- c) Man-hours required for each task,
- d) Replacement parts required at each examination, inspection or overhaul,
- e) Different levels of maintenance activities.

3.24.4 Spares Management Plan

The Contractor shall submit the Spares Management Plan not less than 180 days prior to the proposed date of issue of the Taking Over Certificate for the Works. As part of spares management plan the contractor shall:-

1. Submit for review by the Engineer a Spares Management Plan to furnish a priced manufacturer-recommended list of spare parts, necessary to support continuous operation of all such equipment for a minimum period of 24 months after the commencement of Revenue Operations.
2. Supply the spares, test equipment etc. as per the respective Particular Specifications. The Contractor may please note that all Spares needed for replacement during Defect Notification Period shall be resourced separately and shall not be allowed to use the mandatory spares as identified in PS during the construction or Defect Notification Period.

3.25 DEFECT LIABILITY MANAGEMENT PLAN

3.25.1 The Contractor shall submit for review by the Engineer a Defect Notification Plan to repair, replace and perform any remedial item upon the Works identified by the Engineer during the Defects Notification Period. The Contractor shall:

- a) Endeavour to complete all necessary work in a timely responsible manner;
- b) Not proceed with any remedial work without the consent of the Engineer;
- c) Submit a plan that details the methods and timing of any proposed work; and
- d) Update the plan monthly, showing progress of the work and the time to completion.

(End of Chapter 3)

CHAPTER 4 - PROJECT PROGRAM REQUIREMENT

4.1 GENERAL

- 4.1.1 The Contractor shall develop in detail, a logical method of executing the Works taking into account their complex nature and different phases and shall provide Project Implementation programs which reflect the detailed planning undertaken for implementation of the project.
- 4.1.2 The programs shall start with the Commencement Date of the Works as day one, are to be realistic, achievable and shall be accompanied by the detailed supporting Management Plans.
- 4.1.3 The Program activities shall be discrete items of work, which when combined and produces the definable elements, components, Milestones, Stages and Sections of the Works and clearly identify the completion obligations of the Contractor.
- 4.1.4 Milestones shall be an integral part of all Programs and all activities. Sequencing and interrelationships required to achieve each completion obligation shall be shown. Milestones shall not impose constraints that in a way affect the Program logic. Milestones shall not be introduced into any Program as constrained dates.
- 4.1.5 The critical path shall be clearly identified in the Program and fully described in the accompanying Program narrative.
- 4.1.6 Activity descriptions shall clearly convey the nature and scope of the Works. Programs shall take into account the activities of Precursor, concurrent, adjacent and follow on project contractors and any other activity that may affect the progress of the Works.
- 4.1.7 The Contractor shall also incorporate the Engineers requirement for additional activities, to further explain or subdivide complex or long duration tasks, without affecting completion dates.
- 4.1.8 The Contractor shall monitor its and its subcontractor's performance against programs to ensure its compliance with its obligations under the Contract. Monitoring of the Works shall include direct, daily monitoring of the progress of the Works and the preparation of return and computerized reports to be submitted to the Engineer. The reports shall include all necessary supporting data to apprise the Engineer of the status of the completion of the Works as described below:
- 4.1.9 The following Project Program submission shall be developed and submitted by contractor for the Engineer review within number of days (from the Date of Commencement) as specified below : -

Program Submission

S.No.	Programs	Submission
1.	Survey Plan and Program for Validation of Data Provided by Employer and Additional Surveys, if required by the Contractor.	56 Days
2.	Work Program	
2.a	Initial Version	56 days
2.b	Full Version	84 days
3.	Design Submission Program	56 Days
4.	Procurement Management and Manufacturing Program	90 Days

5.	Installation Program	180 Days
6.	Testing & Commissioning Program	180 Days
7.	Training Program	180 days

4.2 THE EXECUTION PHASES

The execution activity will include various phases of the implementation. The term Phases means a kind of stages of execution a system/ subsystem works or of a component or activity as generally would take place in a sequential manner. The next stage of activity can commence immediately after the completion of previous related activity. The Contractor will have generally following Execution Phases.

- a. Design Phase,
- b. Procurement, Manufacturing and Supply Phase,
- c. Construction/Installation Phase,
- d. Testing & Commissioning Phase and
- e. Defect Notification Phase.

4.2.1 Design Phase

The contractor shall deploy the qualified team of the design Engineers and Experts as approved by the Employer Evidencing the experience of the design in relevant field and technology before commencement of Design Phase. The Design Phase shall be in 4 stages as detailed below:

- a. Preliminary Design,
- b. Detailed Design,
- c. Construction / Installation Design & drawings and
- d. As Built Documents.

4.2.2 Procurement, Manufacturing And Supply Phase

The Procurement, Manufacturing and Supply phase will constitute the following:

- a. Manufacturing / Procurement, ,
- b. Factory Acceptance Tests (FAT),
- c. Delivery to the contractor's stores at site and
- d. Storage at the site Stores including establishing the Material Procurement tracking, receipt and issue procedures.

4.2.3 Construction & Installation Phase

Construction & installation Phase will constitute of the following:

- a. Site Management including access/ ROW, and preparation thereof;
- b. Availability of Construction reference Drawings;
- c. Installation preparatory works like Foundations, first fix, site safety and quality assurance procedures etc.;
- d. Equipment installation and
- e. Submission of verified and As Built Documents.

4.2.4 Testing And Commissioning Phase

Testing and commissioning phase will constitute of the following:

- a. Testing and Commissioning of all subsystems;
- b. Quality assurance and RAMS demonstrations;
- c. Integrated Testing & commissioning
- d. Trial run including service trial
- e. Submission of Verified and As Built Documents.

4.2.5 O&M And Defect Notification Phase

The contractor shall develop a detailed Plan for Defect Notification Phase in consultation with the Engineer taking into account the Traction and E&M System/ subsystems/ equipment, Interface, RAMS demonstrations, Hazards not mitigated in the construction stage and carried forward to operation stage, maintenance support, T&P and spares created and the OEM's Recommendations on Maintenance support system etc. meeting the Operation & Maintenance requirement as under:

- a. O&M activities,
- b. Defect Notification Activities and plan,
- c. Work shop Repair activities,
- d. Support & Call out services,
- e. RAMS demonstration and
- f. Supply of O&M Manuals, Maintenance Schedules.

4.3 WORKS PROGRAM

4.3.1 The Works Program to be submitted under the contract shall be developed from the Outline Works Program as submitted by the contractor during the bid submission. The Work Program shall include a period for review by the Engineer/ Employer's Personnel of all stage of document submission while making overall project timeline adjusting various other activities. The Key Dates are given in Appendix-15 of the GS. All the Key Dates must be adhered with the Works Programme.

4.3.1 The Contractor shall prepare and submit for review by the Engineer, his proposed **initial version** of the Works Program which shall provide full program details for the first six months of the contract and shall provide outline details for the remaining period of the contract.

4.3.2 The Contractor shall prepare and submit the **full Version** of the Work Program subsequently for review and approval of the Engineer.

4.3.3 The Works Program shall demonstrate by reference to its Sub Programs, Supplementary Programs and associated Management Plans, the sequence and duration of the activities and any restraints there so that the Contractor shall adopt to achieve Milestones and to fulfill all Contract obligations. The Works Program shall become the basis of administration of the time-related aspects of the Contract.

4.3.4 The Contractor shall provide the Engineer with substantiation for each constraint whether target start, target finish or mandatory constraint entered by the Contractor into the Works Program. The number of constraints shall be kept to an absolute minimum.

4.3.5 The Works Program shall include activities for all the phases and stages of the Works, clearly showing all logical interdependencies and stages in the development of

the Contractors design, procurement, installation, commissioning and setting to work. As a minimum, it shall include'

- (1) All works comprising the permanent works;
- (2) Preparation, submission and review of Design Documents showing all items where review by the Engineer is required.
- (3) Procurement of all major materials and items of Contractor's Equipment for the Works, including the dates orders are to be placed, manufacture period and the expected delivery date to the Site for each item.
- (4) Any software development requirements and Validation time frames.
- (5) All manufacture or prefabrication of materials of components.
- (6) All design and installation of major Temporary Works.
- (7) All activities associated with securing necessary permits and other statutory approvals for the works.
- (8) Access and availability dates for all Project Contractors.
- (9) All interfaces related to the project that may affect the progress of the Works.
- (10) Testing and commissioning activities requirements.
- (11) Training.

4.3.6 The Works Program shall be divided into Sub-Programs of manageable size addressing in more specific detail. The Sub-Program shall be as follows:

- (1) Design Submission Program
- (2) Procurement Management and Manufacturing Program
- (3) Co-ordinated Installation Program
- (4) Testing and Commissioning Program; and
- (5) Training Program

4.3.7 The submission of the '**full version**' of the Works Program shall include the Design Program, Procurement and Manufacturing Program and a preliminary version of the Installation Program and the Testing and Commissioning Program identifying all major installation, testing activities and associated interfaces.

4.3.8 The Sub-Program shall be further substantiated by the supplementary Programs as required by the Engineer.

4.3.9 The Contractor's Works Program shall comply with the following:

- (1) All program submitted in both hard copy and electronic data format.
- (2) All program shall be prepared using the latest version of CPM scheduling software Primavera Project Planner or similar.
- (3) A standard Gregorian calendar shall be used for planning and execution of the Works. All Program submissions shall include details of the Contractor's allowance for Public Holidays and known-work periods. If a Milestone falls on a public holiday or non-work day it shall be effective the next working day.
- (4) The planning unit for the duration of all Program activities shall be the day. Any activity having duration of more than 28 days shall be divided into sub activities that shall not exceed 28 days.

- (5) CPM program shall reflect status using remaining duration and percent complete.
- (6) All program shall be fully resource loaded as appropriate or required by the engineer covering all stages and aspects of the Contract and shall include, but not be limited to:
 - a. Major manpower for both design and installation.
 - b. Number of items of Contractor's Equipment.
 - c. Number of drawings and other design deliverables.
 - d. Principal quantities of components or parts.
 - e. Principle quantities of bulk materials inclusive of cabling, pipe, ductwork and equipment item etc.

4.3.10 All programs constituting the Works Program shall be organized in a logical work breakdown structure including work stages or phases. Each activity shall be coded to indicate, as a minimum, the work group or entity responsible for the activity, the area, facility or location and the Cost Centre in which the activity is included, from information provided in the pricing schedules. Milestones shall be coded so as to be separately identifiable. The Contractor may be required to assign additional activity codes as required by the Engineer.

4.3.11 The Contractor shall make provision for the time required for completing the design, design reviews/ approvals, revisions, construction, procurement, manufacture, supply, installation, testing, commissioning and integrated testing of the Works.

4.3.12 This period shall include but not be limited to design co-ordination periods during which the Contractor shall co-ordinate its design with those of interfacing parties, review procedures, determining and complying with the requirements of all government departments and obtaining all necessary permits.

4.3.13 This period will include co-ordination with all others whose consent, permissions, authority or license is required prior to the execution of any work.

4.3.14 The Work Programs including supportive details and revised versions shall be submitted to the Engineer for his consent in accordance with the provisions of the conditions of Contract.

4.4 DESIGN SUBMISSION PROGRAM

4.3.15 The Contractor shall prepare the Design Submission Program (for Design Phase and Construction Phase) which is to set out fully the Contractor's anticipated program for the preparation, submission by the Contractor and review of the Design Packages, the issue of Notices by the Engineer for all stages of design. The 'Design Submission Program' shall cover all submissions during the Design Phase and the Construction Phase.

4.3.16 The Submission Program shall ensure that all submissions are properly co-ordinated with the Contractor's overall Works Program, particularly in respect of the following:-

- (i) Progress of design,
- (ii) manufacture, installation and testing work;
- (iii) Co-ordination with other Contractors;

4.4.3 Due allowances for the Engineer review process and the time needed for any re-submissions to be undertaken.

- 4.4.4 The Design Submission Program shall:
- a. be deemed to be consistent with relevant Coordination Dates and latest work program;
 - b. identify dates and subjects by which the Engineer's response should be made;
 - c. make adequate allowance for periods of 28 days for review by the Engineer with extra time for the review of other bodies, if necessary;
 - d. establish correlations by identifying, describing, cross-referencing and explaining the various Design Submissions including multiple submissions of the design for the different Work Segments;
 - e. make adequate time allowance for the design and development of the specialist works /sub-contractor works
 - f. indicate the interfacing design activities in respect of each of the other contractor / Interfacing Parties and external related parties and
- 4.4.5 The Contractor shall keep the Design Submission Program updated at intervals of not more than three (3) month throughout the Design Phase. Such updates shall be included as an exhibit in the Contractor's Monthly Progress Report.

4.5 PROCUREMENT MANAGEMENT & MANUFACTURING PROGRAM

- 4.5.1 The Contractor shall prepare and submit for review by the Engineer Procurement Management & Manufacturing Program that shall be an integrated part of the overall Works Program.
- 4.5.2 The Procurement Management & Manufacturing Program shall show the interdependencies between engineering disciplines as well as between the contractor and its subcontractors and suppliers. This Program shall demonstrate compliance with the requirements of the Submissions Program.
- 4.5.3 The Procurement Management & Manufacturing Program shall include a separate breakdown, supported by Material Controlled Schedule, which shall be a complete amplification of the Contractor's Program and equipment list, including those items which are subject to long lead time or component parts which are manufactured from countries outside the country of assembly and testing.
- 4.5.4 The Material Controlled Schedule shall be automated, and shall detail the following information for each permanent major and minor material and significant component. The format such a schedule shall include:
- (1) Name, description, supplier/sub-supplier details.
 - (2) Drawing information (where appropriate), title, drawing status, submission dates, shop drawings/fabrication drawing preparation etc.
 - (3) The manufacturing process, manufacturing of test pieces, trial production, Engineer inspection, monthly production of components and monthly supply of components.
 - (4) The assembly process, erection and assembly sequences (particularly for the first pieces) prior to shipment, test assemblies, monthly assembly requirement, engineers inspection, testing of assemblies and
 - (5) Transportation process, quality release from factory, factory storage to dock and shipment.
- 4.5.5 The Contractor shall continuously maintain this schedule and report upon the status of

each item as part of the contractors regular progress reporting.

- 4.5.6 From this base data, the Contractor shall prepare and an exception report detailing all components that are in delay. This report shall be annotated with the reason for the delay and indicate what action the contractor is taking to recover the lost time.
- 4.5.7 The Contractor shall submit, as part of the Procurement and Manufacturing Program, Factory Acceptance Testing Program that shall describe all activities of the Factory Acceptance Tests.
- 4.5.8 The Factory Acceptance Testing Program shall be fully detailed, with the activities individually identifying all tests for which a certificate will be issued, and shall include activities for preparation, submittal and review of the test procedures.
- 4.5.9 The Factory Acceptance Testing Program shall demonstrate the logical dependencies between the individual tests of the works, and shall also show the interfaces and dependencies with the Contractor's delivery Program.
- 4.5.10 The Factory Testing Programme shall include details of inspection, testing and witnessing of the contractor's and sub-contractor's procurement and manufacturing activities. As a minimum, it shall include:
- (1) First article inspection;
 - (2) Quality Hold Points;
 - (3) Quality Control Points;
 - (4) Type Tests; and
 - (5) Routine Tests.

4.6 INSTALLATION PROGRAM

- 4.6.1 The Installation Program shall be submitted as stated in the PS or as directed by the Engineer. The Installation Program shall comply with the requirements of clause 4.3.10 above.
- 4.6.2 The Program shall include detailed activities describing all aspects of the installation of the works, to meet all Milestones given in the contract. It shall be clearly linked to the Design Program, Procurement Management & Manufacturing Program and Testing and Commissioning Program to form an integrated part of the Works Program.
- 4.6.3 The Installation Program shall be fully supported by the Procurement Management & Manufacturing Plan and Co-ordinated Installation Plan.
- 4.6.4 The Installation Program shall indicate the physical areas to which the contractors requires access, access dates, duration required and the required degree of completion for civil or architectural finishes prior to the access date.
- 4.6.5 The Installation Program shall take into account the requirements for arrival at port, delivery, storage, preservation and positioning of large items of the contractors equipment and permanent works and shall set out the contractors proposed delivery route for such items to the site.
- 4.6.6 All Installation tests shall be clearly shown in the Installation Program and shall include those interface tests required to be carried out by others to establish a time table for these tests.
- 4.6.7 Activities that may be expedited by the use of overtime, additional shifts or by any other means shall be identified and explained.
- 4.6.8 The Contractor shall highlight in his Installation Program any item, material, equipment,

resource and support required from the 'Other Contractors with dates, duration and locations.

4.6.9 The Contractor shall ensure sufficient floats or slacks in all activities and avoid critical paths built in his Installation Program. In case critical paths cannot be avoided, the Contractor shall highlight any critical paths for the Engineer's attention.

4.6.10 In preparing the Installation Program, the contractor should note that the following conditions shall apply:

- (1) The Contractor shall not have exclusive access to any part of the site except by the specific consent of Engineer.
- (2) The Contractor shall take note that concurrent time allocations for certain areas may be given to more than one contractor. The contractor shall coordinate his works in such areas with that of project contractors through the Engineer.
- (3) The absence of a Program date or installation period for the contractor in a specific area shall not prejudice the right of the Engineer to establish a reasonable Program date or installation period for that area.
- (4) The Contractor shall propose contingency plan to ensure that all the major Milestones can be met in case there is slippage in the installation activities.

4.7 TESTING & COMMISSIONING PROGRAM

4.7.1 The Testing & Commissioning Program shall be submitted as stated in the PS or as directed by the Engineer and shall comply with the requirements of the clause 4.3.10 above.

4.7.2 The Contractor shall submit the Program that shall fulfill all the on-site testing & commissioning requirements. The Program shall clearly demonstrate the logic and highlight topics listed in the On-Site Testing and Commissioning Plan.

4.7.3 The Program shall be fully detailed, with activities individually identifying all tests for which a certificate will be issued, and shall include activities for preparation, submittal and review of the test procedures.

4.7.4 The Program shall demonstrate the logical dependencies between the individual tests of the Works, and shall also show the interfaces and dependencies with all of the Project Contractor's tests required to commission the Works and support the Commissioning Plan.

4.8 TRAINING PROGRAM

4.8.1 The Contractor shall prepare and submit for review by the Engineer, a Training Program covering all proposed formal training courses, delivery of training equipment and accesses by the Employer's personnel.

4.8.2 The Training Program shall be sufficiently detailed that the Employer can ensure the availability of staff for all the courses.

4.8.3 The Training Program shall include the requirements of Chapter-13: "Training and Transfer of Technology" including the Training activities of all sub-contractors and suppliers.

4.9 THE PROJECT CALENDAR

- 4.9.1 The Project Week shall commence on a Monday. A day shall be deemed to commence at 00:01 hour in the morning of the day in question.
- 4.9.2 Where reference is made to the completion of an activity or Milestone by a particular week, this shall mean by midnight on the Sunday of that week.
- 4.9.3 A 7-day-week calendar shall be adopted for various Works Programs which shall also display the rest day and holiday(s).

4.10 PROGRAM SUBMISSIONS

- 4.10.1 The Contractor shall submit all Programs described in this Chapter in conjunction with the Management Plans described in Chapter-3 of GS to the Engineer.

4.11 PROGRAM REVIEW

- 4.11.1 The Engineer shall, within 28 days of receipt of the initial submission of any Program for review, either give a notice of no objection or provide specific details as to why a notice of no objection is not given. If the Contractor is advised that the Program is not given a notice of no objection, the Contractor shall amend the Program taking into account the comments and/or requirements and resubmit the Program within 14 days.
- 4.11.2 In the case of further resubmittals, the resubmission time shall also be 14 days.

4.12 WORKS PROGRAM REVISIONS

- 4.12.1 The Contractor shall immediately notify the Engineer in writing of the need for any change in the Works Program, whether due to a change of Scheme, Design or circumstances or for any other reason. Where such a proposed change affects the timely completion of the Works or any Section or Stage: the Contractor shall within 14 days of the date of notifying submit for the review his proposed revised Works Program and accompanying Program Analysis Report. The proposed revised Works Program shall show the sequence of operations of all work related to the change and the impact of the changed work or changed conditions on the works and Project Contractors and their works.
- 4.12.2 If at any time the Engineer considers the actual or anticipated progress of the work reflects a significant deviation from the Works Program, he may request the Contractor to submit a proposed revised Works Program. Upon receipt of such a request the Contractor shall submit within 14-days a revised Works Program, together with an accompanying Program Analysis Report and Narrative Statement that shall demonstrate the means by which the Contractor intends to eliminate the deviation.

4.13 PROGRAM ANALYSIS REPORT

- 4.13.1 The Contractor shall submit a Program Analysis Report that shall, in narrative format, describes the basis and assumptions used to develop all Program submissions. The Program Analysis Report shall be prepared in a format having been reviewed without objection by the Engineer and contain as a minimum the following:
- (1) Cycle times and work sequences;
 - (2) The deployment of Contractor's Equipment and labour;

- (3) The production rates used in determining duration;
- (4) The shifts assumed in determining duration;
- (5) The breakdown of labour requirements by trades;
- (6) The schedules of quantities used in developing the Program, to the extent that such information is not provided elsewhere;
- (7) Interfaces with the Engineer and Project Contractor's and other constraints; and
- (8) Any assumptions used in the Program.

4.13.2 The Program Analysis Report shall be in sufficient detail to enable the duration, leads and lags in logic diagram to be reconciled and substantiated, and to enable the projected levels of labour (by trade) and staff and flows of goods, materials and equipment to be substantiated.

4.14 MILESTONES

Milestones have been derived from Conditions of Contract. These are the broad key deliverables and Contractor is required to develop project program to achieve these deliverables and dates. Accordingly contractor should set his own internal targets which are commensurate with these Milestones and incorporate in his all internal schedules for approval of Engineer. The details of Milestones are mentioned under appropriate clauses in Part 3, Section VIII of Bidding Documents.

4.14.1 Milestone Report

- (1) The Milestone Report shall be prepared in a format reviewed by the Engineers Representative and identify and state the status of :-
 - a. All Milestones that are planned to be achieved in the reporting period or earlier but have not been achieved;
 - b. All Milestones that have been achieved in the reporting period;
 - c. All Milestones that are planned to be achieved in the next reporting period; and
 - d. Any Milestones that appear unlikely to be achieved on time.
- (2) The Milestone Report shall identify for all relevant Milestones, the planned dates, the actual dates achieved, and where the original planned dates are forecast to be unachieved, the revised dates identified in the contract, as the same may be revised time to time in accordance with the contract.
- (3) The Milestone Report shall also provide an explanation for any deviation from the planned dates. Measures taken or required to recover the Program delays shall also be identified.

4.15 MONITORING OF PROGRESS

The Contractor during the progress of the Works shall constantly monitor its own and its subcontractor's performance to ensure its compliance with its obligations under the Contract and progress as per agreed Work Program. The Monitoring of the Works shall include direct daily monitoring of the progress of the Works and preparation of written and computerized reports to be submitted to the Employer's Personnel and the Engineer as required. The Progress reports submitted shall include all necessary supporting data

of the status of the completion of the Works including preparing and submission of PERT/ CPM/ BAR/ GANTT charts and "S" Curves.

4.16 PROGRESS REVIEW MEETINGS

- 4.16.1 The Engineer/ Employer's Personnel will conduct Progress Review Meetings (PRM) to be held monthly with the Contractor at appointed dates and times.
- 4.16.2 The Employer's Personnel /Engineer may convene at his discretion, at any time upon reasonable notice to the Contractor, any meeting, either on or off the Site, to discuss and address any aspect of the Works or the Contract.
- 4.16.3 The Contractor shall attend monthly Progress Review Meeting or any other meetings called by the Employer's personnel / the Engineer in order to review the arrangements for future work, Works in progress or other issues set out in the Meeting Agenda. The meetings shall be attended by the nominated Project Manager/ Deputy Project Manager(s) of the Contractors, and his support Experts of Relevant fields/ activities and other Senior personnel who shall arrive properly briefed for all aspects of the meeting and shall be empowered to make executive decision in respect of the execution of the Works.
- 4.16.4 The Minutes of the Meeting (MOM) signed & issued by the Engineer shall constitute an official record of matters discussed. However, such MOM shall not replace or dilute any of the Employer's requirement specified in the Contract. The Contractor shall take specific approvals, instructions or decisions in writing from the Engineer for all documentations and submissions as specified. Such meetings may be attended by representatives of all Interfacing Parties and other stakeholders as deemed fit by the Engineer.
- 4.16.5 A first meeting as a 'Kick off Meeting" of the work/project shall be organized within two weeks of 'Letter of Acceptance (LOA)'. The meeting shall be attended by Contractor's Representatives and Employer's Personnel / the Engineer. During the meeting the activities related to the project planning, scheduling, and monitoring and control shall be discussed and finalized as required including planning on deliverables for project monitoring & control, Works Program and other Inputs as desired by the Employer.

4.17 MONTHLY PROGRESS REPORT

- 4.17.1 The Contractor shall prepare Monthly Progress Reports covering all aspects of the execution of the Works. Such Monthly Progress Reports shall be in writing and shall be delivered to the Engineer by the 7th day of the month following the month of Monthly Progress Report. The Monthly Progress Report shall take account of work performed up to and including the last day of the month to which the monthly progress report relates and shall be prepared in accordance with Chapter-15, Appendix-1: "Monthly Progress Report".
- 4.17.2 The Monthly Progress Report shall include an executive summary and contain clear and concise statements in respect of every significant aspect of the Works including, without limitation, the requirements specified in this Specification.
- 4.17.3 The Monthly Progress Report shall contain evidence that document and supports the progress of the Works to the satisfaction of the Engineer.
- 4.17.4 The Reports, documents and data provided shall be an accurate representation of the current status of the Works and of the work to be accomplished and shall provide the Engineer with a sound basis for identifying problems and deviations from planned work and for making decisions.

- 4.17.5 Important events, construction/Installation activities working of new machinery, weather effects or any occasion advised by the Engineer shall be video graphed. The recording shall be done or converted to .avi format and presented in electronic storage device with appropriate voice recording describing the event.

4.18 QUARTERLY REVIEW MEETINGS

- 4.18.1 The Employer may convene Quarterly Review Meetings at approximately three months intervals. The Engineer will notify the Contractor the date of such Quarterly Review Meetings not less than 14 days before they are to be held.
- 4.18.2 Quarterly Review Meetings shall be held to review the overall progress of the Works in the context of the Project as a whole and to address and resolve any issues relevant to the execution and progress of the Works. Such Quarterly Review Meetings will be chaired by the Employer or his delegate. The Contractor shall have in attendance of one senior representative of the Director level from each of the companies acting as leader or sponsor of the Contractor if it is a Joint Venture, Consortium or Partnership whenever necessary and required by the Engineer.

4.19 IT REQUIREMENT FOR HRIDC

- 4.19.1 "HRIDC shall be in the process of implementing an Enterprise wide IT System. In view of ERP package SAP being implemented in HRIDC, Contractor must provide the following data to HRIDC Head Office/CPM Offices in the Microsoft Excel Templates/Format released by HRIDC Head Office/CPM Offices.
- 4.19.2 As part of scope of work the Contractor will ensure the following:
- (1) Ensure that required data of the Contracts Work Program and Physical progress of the activities defined in the Works Program must be provided in the templates defined by HRIDC to be uploaded in the system using software defined by HRIDC.
 - (2) Work Program, Revised Works Program and Revision in Planned Work in the Activities, would also be uploaded in the system using software defined by HRIDC through templates provided by it.
 - (3) In order that the Works Program Data provided by the Contractor could be uploaded as it is in the system, Contractor must adhere to the following conditions regarding the length of the Codes/Numbers defined in their project Management Tool (e.g. Primavera or Microsoft) for the Project Structure Elements:
 - a. Project ID/WBS Element Codes/Numbers must be unique and must not exceed a maximum length of 20 Characters (Alpha Numeric).
 - b. Activity IDs/Numbers must not exceed a maximum length of 4 Characters (Alpha Numeric).
 - (4) Upload of drawings and designs created by Contractor as per the classification using document management system of SAP.
 - (5) Online measurement book entry (Record of Works) and all bills along with supporting documents as per the screens defined by HRIDC.
 - (6) Asset details needs to be updated in the system in format prescribed by HRIDC.
 - (7) GIS (Geographical Information System) application will use Autodesk suite (MAP 3D as desktop GIS & AIMS for WEB GIS) and Oracle 11g/spatial as a central repository. Information about the assets details (i.e. alignment drawing coordinates and attributes) will be provided by the contractors. Network asset details in the

form of maps, reports will be available to all the authorized users through web as soon as the asset details are submitted by the contractors and imported in the system.

- a. Geo-referencing of alignment on WGS-84 coordinates.
- b. Capture and upload of geo-referencing coordinates of the assets in to GIS.

4.19.3 Contractor need to feed/provide the data in the IT system as per mechanism and method devised by HRIDC. For putting data into system Contractor needs to make arrangement of connectivity, if required and also needs to bear the cost of any licensees required for the Contractor to access the HRIDC IT System.

4.19.4 In case interoperability is required for movement of information and data in a seamless manner between contractor IT system and that being developed by HRIDC, it will be the responsibility of the Contractor to ensure the same.

(End of Chapter 4)

CHAPTER 5 - DOCUMENT MANAGEMENT

5.1 GENERAL

- 5.1.1 During the life cycle of a project, contractor would be required to produce different types of documents to facilitate the planning, tracking/ monitoring progress and reporting of the project. Documents range from Studies/ Reports, Management Plans, Resource plans, financial plans and project Implementation Program, Design & Process documents, Calculations, Drawings, Vendor Technical Specifications, supplier contracts, post-implementation reviews, change request forms and project status reports etc.
- 5.1.2 It shall be ensured by the Contractor that documentation meets the Purpose and the content is sufficiently detailed to communicate fully. Success of project is crucially dependent on documents produced for it.
- 5.1.3 The Contractor shall maintain a PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS) and share the information with the Employer's PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS) as per details in Chapter-15, Appendix-7: "PMIS Requirements and Procedures".
- 5.1.4 The Contractor shall comply with the following requirements of the Employer regarding the Document Management System.
- a) Document Flow Process,
 - b) Document Approval Process,
 - c) Document and Drawing Numbering System,
- 5.1.5 The Contractor shall submit hard copies of all drawings, data of the documents and copy of transmittal along with a soft copy transfer electronically in the agreed format. Contractor will share the softcopies as advance information. However the reviews will only be made on hard copies and shall be preserved in hard copies with endorsed signed copy. The work shall be executed based on the latest hardcopies of the drawings and documents.

5.2 TYPES OF DOCUMENTS

- 5.2.1 The Contractor shall identify the requirement of Documents, designs, drawings and furnish a Document Management Plan. Types of documents that would be required to be submitted by the contractor are as enumerated below but not limited to:
- 1) **Reports and Studies**
Inception Report, Simulation study, Site Survey reports, Monthly / Quarterly Progress Report, Inspection Reports, Notes of Discussions/ Minutes of Meeting(MOM)/ Investigation Reports etc.
 - 2) **Project Management Plans**
As per Chapter 3
 - 3) **Programs & Schedules**
As per Chapter 4
 - 4) **Process & Procedures documentations**
Specification Design/ document/ Drawing submission, approval of technology/ equipment, Method Statement, Makes, Alternate options, Design Change, site access, handing over, etc.

5) Design phase submissions

Design phase submission will constitute the following :

- a. Preliminary Design Submissions along with Design Report, Scheme/ Drawing, Calculations and supportive documents;
 - b. Detailed Design submissions along with Design Report, Scheme/ Drawing, Calculations and supportive documents;
 - c. System Requirement Specifications, Proofs & Evidences of achieved System assurance and RAMS with V&V, Check lists and
 - d. Vendor Performance Specifications and Drawings.
- 6)** The manufacturing / supply phase will constitute Manufacturing by OEM Factory Acceptance Tests (FAT) and delivery to the contractor's stores at site.
- 7)** Construction / installation, testing and commissioning phase submissions will constitute the following:
- a. Equipment installation drawings,
 - b. Construction Reference Drawings,
 - c. Interface Management and combined Services Drawings,
 - d. Monitoring, Control & Protection Logics and fault diagnostics,
 - e. O & M and Design Manuals with Itemized specifications, monitoring & Control Process, Diagnostics and O&M procedures with test results reports,
 - f. As built drawings with Drawings for all equipment and sub-systems/systems supplied & installed, location wise Equipment Bill of quantity, Asset Register,
 - g. RAMS demonstrations reports and
 - h. Process papers for Permits and approvals.

5.2.2 For the Equipment, sub-system and components therein, the Contractor shall submit documents and drawings describing function description, product description, interface requirement description, RAMS requirement description, Life cycle calculations, type test & routine test specifications, list and details of spares, related calculations etc.

5.3 DOCUMENT CONTROL PROCEDURE

5.3.1 Within 28 days after Commencement Date, the Contractor shall submit a Document Control procedure to the Engineer for review as below but not limited to;

- a. The document shall be well organized. It shall have a clear logical sequence and should be organized in chapters, sections, and sub-sections with meaningful headings, including diagrams, tables, or figures whenever appropriate.
- b. The document shall be self-contained as far as possible without much cross references, unless otherwise there is a reason to do so.
- c. The Contractor shall use configuration management to ensure that the system is correctly configured. The Contractor shall ensure that a configuration control program is maintained. The Program shall ensure that the configuration of each item is recorded and maintained during the life of the Contract including Defect Notification Period.
- d. Every document and drawing shall have a unique traceability. The Contractor shall ensure that all submissions are correctly numbered in accordance with the

schedule. The sequence code shall be a unique sequential number for each submission for each particular subject. Revision numbers shall be used when a re-submission is required. The resubmission shall have the reference of the previous revisions including the revisions of the references used in the drawings and documents to ensure traceability.

- e. Each Document and Drawing shall have a title, Document number, Revision Number, Date and list of Reference documents/ drawings (along with Reference Number, Revision and Date). The revision status and date of preparation of the submission shall be clearly indicated at the header of each page of the submission.
- f. The Documents and CAD drawings shall be described, Titled, numbered and detailed as per the Appendix-2 of this GS.
- g. To establish integrity of the Document / Drawings, each sheet / page of the submission shall be sequentially numbered giving page number of the document with reference of total pages i.e. x page no. of y pages. Every Para of the document shall be sequentially numbered without duplication of para numbers.

5.3.2 Each document shall be accompanied by a brief Explanatory Notes / introduction / Report to explain the Purpose, which subsystem - part of the Works to which the submission refers to, lists of the documents enclosed, with the submission and describing in outline how all relevant requirements of the Employer's Requirements are achieved by the proposals.

5.3.3 The Contractor's document approval system shall specify the level of authority for approval of all documents before submission to the Engineer and in accordance with Quality Assurance.

5.3.4 The system of issuing documents shall ensure that pertinent documents are issued to all appropriate locations.

5.3.5 A document change or re-issue system to ensure that only the latest revision of a document can be used; and should contain:

- i. Contract number;
- ii. Discipline;
- iii. Submission reference number;
- iv. Revision indicator and date; and
- v. Description of Change for each revision with clouding and flagging in the drawing.

5.4 REQUIREMENTS OF DOCUMENT SUBMISSION

5.4.1 All the documents, drawings and Designs shall be submitted with the endorsement thereon the Documents as under:

- a. Certificate of the contractor in the effect that "the submission is prepared, checked and issued by the qualified engineers of the Contractor" conform to the satisfactory, safe and reliable performance,
- b. Statement of Exception/ Deviation from the Contract: 'NIL'

5.4.2 Deviation if any to the particular specification shall be got approved before implementation from the Engineer in writing and endorsed in this effect on all documents affected by such deviation.

5.4.3 The documents involving Field changes in the approved design or due to site constraints

shall be endorsed by the contractor with a Statement of "NO additional financial implication" unless approved otherwise by the Engineer.

5.5 DRAWINGS PRODUCED BY THE CONTRACTOR

5.5.1 Drawings produced by the Contractor shall generally be ISO A-1 size or as desired by the engineer for the followings;

- a. Schematics,
- b. General Arrangement Drawings,
- c. Site layouts, Equipment layouts,
- d. Construction Reference Drawings of Permanent works,
- e. Combined Service drawings,
- f. Detailed Interface Drawing,
- g. Drawings for Temporary Works etc. and
- h. Revised drawing due to design/ site changes.

5.5.2 They shall display a title block with the information as detailed herein Drawing and CAD Standards duly quality checked and Sign endorsed by the Preparer, Checkers and issuer along with the Design Certificate.

5.5.3 The contractor shall provide six sets of all stage drawings along with read only electronic version of the same on Electronic Media to the Engineer.

5.6 LEVEL / QUANTUM OF SUBMISSION

The Contractor shall adopt top-down approach and carryout submissions of the following levels in a logical sequence for review by the Engineer:

- a. System works related submissions shall show the total system including the configuration block diagrams, operating principle, system features and functions, capacity, expandability, interconnection within the subsystem, between subsystems and between other Contract Packages.
- b. Equipment level related submissions shall show the specification on electrical, mechanical and functionality of the equipment/materials employed for the system and the subsystems.
- c. Design calculations shall demonstrate the performance of the system and subsystems.
- d. Installation Design related submissions.
- e. The Contractor shall submit supportive documents, copy of certificates from relevant parties and authorities as required.
- f. Equipment test certificates, Reports, calibration certificates from manufacturers and laboratories

5.7 DOCUMENT SUBMISSION PROGRAM

5.7.1 The Contractor shall submit documents for all the stages - design, manufacturing/supply and Installation, testing and commissioning etc. to the Engineer for 'No Objection'.

**Part-2, Section VII-1: Employer's Requirements - General Specifications (GS)- 2x25 kV AC
Traction Electrification and associated work**

- 5.7.2 The Contractor shall submit a Document submission Program. The submission program shall identify all submissions to be furnished, submission titles, submission numbers and target submission dates for Management Plans and the Drawings of each stage.
- 5.7.3 Submission of Unlisted or undefined proposals / alternate proposal shall not be part of Document Submission Program however shall be addressed in the same manner.
- 5.7.4 The Document Submission Program shall:
- a. Be consistent with and its principal features integrated into the Works Program, and show all relevant Milestones and Key Dates;
 - b. Identify dates and subjects by which the Engineer's decisions should be made;
 - c. Make adequate allowance for periods of time for review by the Engineer and other review bodies;
 - d. Indicate the design interface and co-ordination periods for each Other Contractor;
 - e. Include list of requisite design details for each and every component or equipment of all sub-systems and systems and
 - f. The Contractor shall update the Submittals Schedule suitably in accordance with the observations of the Engineer if any deviations.
- 5.7.5 The Contractor shall submit the Document Submission Program to the Engineer as indicated in Chapter-3 of this GS, and thereafter up-dated versions thereof at intervals of not more than 3 (three) month.

5.8 DOCUMENT SUBMISSION PROCEDURE

- 5.8.1 For each stage of submittal, the Contractor shall prepare a Submission Response Request (SRR) carrying the date of submission, the submission reference number as defined above, the submission title, the stage of submission (e.g. Inception Report, Simulation Report, Detailed Design, etc.), and the signature of the Contractor's Representative:
- 5.8.2 The Documents and Drawings shall be submitted under the signatures of the Project Manager of The Contractors to establish proper issue & Control of the documents. The authority will not be delegated below the rank of Project Manager.
- 5.8.3 The submission shall be accompanied with a checklist duly signed (with name) by the Preparer and Checker of the Drawing/ document.
- 5.8.4 The submission shall be accompanied with Exception Statement on Deviations if any to the Specifications.
- 5.8.5 Each Document / drawings shall be signed by the Preparer (who has prepared the Document/drawing), the Checker (who has checked the document/ drawing) for conformance to specifications, and the issuers (who has verified the document for the purpose, and issued after Careful examination) to demonstrate that document have gone through the process of quality assurance.
- 5.8.6 All the documents, drawings and Designs shall be submitted with the endorsement thereon the Documents as under:
- a) Certificate of the contractor to the effect that "the submission is prepared, checked and issued by the qualified engineers of the Contractor and has been properly reviewed by the Contractor, according to the Contractor's Project Quality Assurance Plan", thereby confirming its completeness, accuracy, adequacy and validity and conformance to the satisfactory, safe and reliable performance,

- b) Compliance with all relevant clauses of the Employer's Requirements;
- c) Conformance to all interface requirements;
- d) Certifying that it is based on auditable and proven or verified calculations or design criteria;
- e) Has taken account of all requirements for approval by statutory bodies or similar organizations, and that where required, such approvals have been granted;

5.9 ENGINEERING REVIEW COORDINATION

5.9.1 Throughout the Design Stage, the Contractor shall attend monthly design review meetings with the Engineer. At these Engineer's review meetings, the Contractor shall present information, drawings and other documents to the Engineer in respect of all submissions Program to occur during the following four week period. The Contractor's presentations shall be in sufficient depth to enable the Engineer to obtain a clear understanding of the Contractor's proposals and to discuss the methodology and process used in reaching the proposed design solutions. Unless otherwise directed by the Engineer, all meetings shall be convened in Engineer's Office or Contractor's Main Office or at the Site Office or at any other location as decided by the Engineer.

5.9.2 The Contractor shall record all of the Engineer's observations and any agreed actions resulting from the Engineer's review meeting and shall address each of these fully before submission of the respective documents for formal review.

5.10 ENGINEER'S REVIEW

5.10.1 The Engineer will complete his review of the submission within 28-days, and communicate review comments in writing or on marked up drawings/documents.

5.10.2 Within two weeks of the receipt of the Engineer's comments the Contractor shall resubmit the submittals/ documents needing resubmission.

5.10.3 Where the comments are minor, the same may be clarified by calculations, part prints, etc. as acceptable to the Engineer and included in the Contractor's next submission.

5.10.4 Should the Engineer considers the submission to be unacceptable, the Contractor shall revise and re-submit the entire submission within two weeks, unless otherwise agreed with the Engineer.

5.11 ENGINEER'S RESPONSE

- 1) The Engineer will respond in one of the following three ways:
 - a. Notice of No Objection
 - b. Notice of Objection (With "A" Comments)
 - c. Notice of No Objection with Comments
- 2) Definition of Engineer's response:
 - a. "Notice of No Objection": if following his review of the submission, the Engineer has not discovered any non-compliance with the Contract, the Engineer will issue to the Contractor a formal "Notice of No Objection" (NONO). A NONO from the Engineer, irrespective of with or without comments does not in any way imply the Engineer's consent of the submission nor does it remove any responsibility from the Contractor for

complying with the Contract. Issue of a NONO from the Engineer entitles the Contractor to proceed to the next stage of the Programed work.

- b. "Notice of Objection (With "A" Comments)": if following his review of the submission the Engineer discovers major non-compliance, discrepancies or omissions etc. that in his opinion are of a critical nature, the Engineer will issue a "Notice of Objection" (NOO) with type "A" comments. The Contractor shall revise and reissue the submission addressing the Engineer's comments. Following the issue of a NOO by the Engineer, the Contractor is not entitled to proceed to the next Programed stage on the path in the relevant network as previously approved by the Engineer until all of the Engineer's comments have been fully addressed and a NONO is issued.
- c. "Notice of No Objection" (With Comments)": if following his review of the submission the Engineer discovers discrepancies or omissions etc. that in his opinion are not of a critical nature, the Engineer may issue a "Notice of No Objection" (NONOC) with Comments. The Contractor shall respond to the comments, agreed and incorporated prior to inclusion in the "Construction Package" Following the issue of a NONOC by the Engineer, the Contractor is entitled to proceed to the next stage of the Programed work subject to the inclusion of amendments necessary to address the comments.

(End of Chapter 5)

CHAPTER 6 - DESIGN REQUIREMENT

6.1 GENERAL

This Employer's Requirement identifies the Design requirement for execution of the HORC 2x25kV AC Electrification and associated works including the preparation and submission of the design of the Systems Works and it shall be read in conjunction with the 'Design Criteria,' Basic Design Philosophy and Requirements for Design and Project Quality Assurance Plan as described in this General Specification (GS) and Particular Specification (PS) and other relevant Appendices. These requirements are subdivided into Design Phase and Construction Phase, and those that are of general application.

- 6.1.1 The Works shall be executed in four phases viz. the Design Phase, the Manufacturing/Supply Phase, Construction/ Installation Phase and Testing & Commissioning Phase.
- 6.1.2 The various phases of the project will overlap with each other. The Design Phase shall have 4 stages – Preliminary Design Stage, Detailed Design Stage, Construction/Installation Design Stage and As Built Documents Stage, overlapping with the various phases of project execution.
- 6.1.3 The Contractor shall ensure that his design is accurate and in compliance with Employer's Requirements and the Specifications which are deemed to be part of the contract as defined in Conditions of Contract. The Contractor shall be responsible to ensure that when the Works are completed, the same shall be fit for the intended purpose as specified in the Contract.

6.2 GENERAL DESIGN CRITERIA

The system designed by the Contractor shall meet the application duty requirement during its serviceable life as envisaged and shall be aesthetic, User friendly, Modular, Expandable, Durable & Maintainable, Environment Friendly, Energy Efficient, EMC/EMI compatible, High Designed life as per the Industry Benchmarks, Meets the Reliability, Availability and Maintainability Standards, interfaced seamlessly with other systems in conformance to safety standards and the specifications.

6.2.1 Durability and Maintenance

- a) The Permanent Works shall be designed and constructed such that they shall endure in a serviceable condition throughout their design lives as described in the Design Criteria and standards contained in the PS and technical specifications to minimize the cost of operation and maintenance whilst not compromising safety or the performance characteristics of the railway.
- b) Equipment(s), where supplied, shall be of a quality and durability to fully meet the performance and operational requirements described in the Design Criteria.

6.2.2 Operational Requirements

- a) The Permanent Works shall be designed to permit the HORC to operate optimum number of trains per hour satisfactorily at a maximum permissible speed for freight trains in accordance with Particular Specifications.
- b) It is a requirement that the Indian Railway (IR) remains operational during the construction / Installation phase.

6.2.3 Aesthetics

The Permanent Works shall be designed to achieve an aesthetic character and provide a feeling of design commonality throughout the project.

6.2.4 Human Factors

The Contractor is required to observe the guidance contained within ISO/TR 16982:2002 and the ergonomic design of systems supplied shall be subject to acceptance by the Engineer.

6.2.5 Environment, Social, Health and Safety Considerations

The design of the Permanent Works shall be according to Indian laws and regulations related to *Environment, Social, Health and Safety* Requirements. *Environment, Social, Health and Safety* aspects shall be kept in mind during the Design/Construction/Installation and Testing & Commissioning phases, requirement for which has been specified at appropriate places in the *Tender* document. It shall be the overall responsibility of the Contractor to ensure compliance of *Environment, Social, Health and Safety* aspects at all times conforming to the provisions mentioned in this *Tender* document.

6.2.6 Quality Control

Quality control aspects shall be kept in mind during the Design/construction/Installation and testing & commissioning phase, requirement for which has been specified at appropriate places in the bidding document. It shall be the overall responsibility of the Contractor to ensure deliverables of quality products at all times conforming to the provisions mentioned in this bidding document.

6.2.7 Reliability, Availability, Maintainability and Safety of Design.

The System Design shall ensure Reliability, Availability, Maintainability and Safety standards, as specified in the Bidding document.

6.3 OBLIGATIONS AND RESPONSIBILITIES OF THE CONTRACTOR

6.3.1 The Contractor shall be responsible for the design, layout, construction/Installation, manufacture, supply, testing and commissioning of the 2x25kV AC Electrification and associated works under the scope of this package and shall ensure that the designs are accurate and in compliance with Employer's Requirements of Particular Specifications (PS) and General Specifications (GS).

6.3.2 The Contractor shall be fully responsible for the suitability, adequacy, integrity, durability and practicality of the Contractor's proposal. The Contractor shall ensure that the Works are fit for the intended purposes meeting application duty requirement.

6.3.3 The Contractor shall undertake that the designers shall be available to attend discussions with the Engineer and Employer at all reasonable times during the Contract period. The Designer shall be the same entity as proposed by the Contractor at the time of pre-qualification unless otherwise approved by the Employer. The Contractor shall furnish Designer's Warranty in the format provided in contract forms of bidding documents.

6.3.4 The Contractor is responsible for assuring the quality of the System designs and shall produce and establish a Quality Management System specifically to meet the Contractual Obligations and Quality Assurance Plan as referred in GS and the PS.

6.3.5 The Contractor shall ensure that the system Designs conform to *Environment, Social,*

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Health and Safety requirements as specified in *Section VII-4 ESHS Manual, Part 2- Employer's Requirements*.

- 6.3.6 Wherever there is any inadequacy in the Employer's Requirements, the Contractor's proposal shall take into account, address or rectify such inadequacy, insufficiency, impracticality or unsuitability. If there are discrepancies between documents referring the same subject, the more stringent criteria shall normally be followed, unless otherwise the order of precedence described in the relevant documents is not applicable.
- 6.3.7 All technical solutions, schemes and materials etc. shall be fully compatible with those used by the beneficiary and should not be in conflict with the applicable rules / codes / manuals and standards as well as legislations in India.
- 6.3.8 The Contractor shall co-ordinate with the Other Designated contractor's viz. Civil, Building, Tunnel, Tracks and S&T and the Contractors working at adjacent sections of HORC etc. to meet the Interface requirement Obligations specified in the Interface Matrix and Interface Management Plan.
- 6.3.9 To demonstrate the compliance to Quality assurance, all the documents, designs and the Drawings shall be signed (with name) /endorsed by;
- who has Designed / prepared,
 - who has checked,
 - who has issued the drawings/ document i.e. the Senior Design Engineer of the Contactor's Design Team.
- 6.3.10 The Contractor shall certify that:-
- The Works have been or will be designed, manufactured, installed and otherwise constructed and to the applicable standards available using proven up-to-date good practice.
 - The Works will, when completed, comply with enactments and regulations relevant to the Works.
 - The design of the Works have taken or will have taken full account of the effects of the intended manufacturing and installation methods, Temporary Works and Contractor's equipment.
- 6.3.11 The Contractor shall also provide an undertaking from the Designer for his Designs for suitability, adequacy, practicality and absolutely meeting the Employer's Requirements as detailed in Chapter-15, Appendix 3: "Design Certificate". The undertaking shall also state that reasonable skill and care expected from a professionally qualified and competent designer experienced in works of similar nature has been exercised. This shall be applicable for such Designs which may be or have been prepared, developed issued by the Employer, or any of Contractor's consultants, his sub-Contractors and/or his qualified personnel/persons or cause to have been prepared, developed or issued directly or indirectly by the Contractor. All the aforesaid shall be applicable notwithstanding the fact that any part of the work may have been inadvertently accepted, passed and paid for by the Engineer or Employer. The Contractor shall endorse a design certificate in requisite format thereby demonstrating that the Designers have fully checked the design as being compliant with all QA procedures and fully compliant with the requirements of the Contract.
- 6.3.12 The Contractor shall, whenever the Engineer so requests, provide information and participate in discussions/ presentations that relate to design matters.
- 6.3.13 Contractor shall furnish all the information as required and as consulted by the Employer in regard to Public Consultations, as specified in Publicity and Public Relations to this

Employer's Requirements.

- a. all plans, programs, reports, calculations, manuals and drawing as specified in 'Document Submission Plan' of this Employer's Requirements and in accordance with this GS and PS of the Systems work to the Engineer to seek the consent of the Engineer and issue "Notices of No Objection".
- b. additional information and supportive documents as required by the Engineer to verify the requirement and / or required for co-ordination of the design of Other Contractors.
- c. The Designs within the specified dates as per 'Document Submission Program' of this Employer's Requirements.

6.3.14 Contractor shall submit the Preliminary Designs, Detailed design, Construction Design, As-Built Documents and other design Documents as specified in Quality Assurance Requirements of this Employer's Requirements.

6.3.15 The Contractor shall carryout Engineering studies and comparative evaluations to ensure that the designs incorporate features to achieve optimum performance of all elements. The design of 2x25kV AC Electrification and associated woks shall be reliable, energy and cost efficient with due considerations to the local climate conditions, safety, ease of installation, operation, maintenance and future replacements.

6.3.16 The Design shall include the Design Calculations in soft and hard copies in verifiable forms including the relevant formulae, Schematics & drawings, Design Manual and checklist etc.

6.4 CONTRACTOR'S ORGANIZATION DURING DESIGN PHASE

6.4.1 Project Organization

- a. Within 28 days of Commencement Date, the Contractor shall submit the Project Organization chart (as a part of Mobilization plan) during the Design Phase, equipped with the functions in a manner as described in 'Quality Assurance Requirements' of this Employer's Requirements. The Plan shall show the management structure and state clearly the duties, & responsibilities and authority of each key and staff member. The Contractor shall keep this plan updated and resubmitted whenever there are changes in the Manpower mobilization plan.
- b. The Contractor shall establish a Design Office at his Main Site Office or at a place agreed by the Engineer.
- c. The Contractor's Personnel/team shall be deployed as per the Mobilization plan.
- d. The Contractor shall propose and deploy qualified, experienced & competent personnel appropriate to the type and magnitude of the design involved in the Design Team with the Engineer's consent for each key personnel during the Design Phase. Full details regarding their qualifications and experience shall be submitted to the Engineer for his consent.
- e. The Contractor's Design Team shall be independent of the Construction Team in his Organization. The Design team shall be carried forward to construction phase design to ensure that the Contractor's design development strictly complies with the Detailed Design which has received 'Notice of No Objection' from Engineer.
- f. ll meetings and discussions relating to design shall be held in the Design office or

in the office of Engineer/Employer and/or as instructed by the Engineer.

- g. The Contractor shall ensure that the Design Team continues to be represented at Site at all times by staff whose seniority and experience are to the satisfaction of the Engineer and whose representative is available on the Site as necessary or as required by the Engineer.
- h. The Contractor shall replace a person of the Design Team immediately if the Engineer/ the Employer's Personnel seek a replacement citing the reasons. The Contractor shall ensure that the demobilization of the person from the site/ office within seven (7) days of the advice and shall have no further connection with the Works in the Contract.

6.5 EMPLOYER'S DRAWINGS & DOCUMENTS

The Employer's Data and Drawings are attached in this Contract Package Part 2, Section VII-3: Tender Drawings' respectively to express the Employer's concept and /or intent bearing functions, purposes and structural forms of the Permanent Works as detailed hereunder:

(1) Alignment Drawings

- a. The Alignment Drawings basically contains the Indicative Horizontal and Vertical Alignment of the Track-ways for the whole Mainline, Connecting Lines, Loop Lines, Sidings (yard layout for each Station) and connecting lines to IR etc. under the Contract; and also the Definite Right of Way (ROW) available all along the Alignment including the Junction / Crossing Stations in line with the list of ROW attached herein as 'Part – 2, Section VII-3:Tender Drawings.
- b. The Alignment Drawings enclosed in the Employer's Drawings are indicative and are further subject to confirmation from the Other Designated Contractor(s) viz., CST.
- c. Contractor shall be responsible for the information's' use, correctness, adequacy and applicability.
- d. Contractor will be responsible for verifying its correctness for his own designs portion of the Design stipulated in the Particular Specifications.
- e. The Contractor shall also ensure that during the Design development the designs include complete scope of work
- f. The contractor's design shall be consistently developed without infringing the Right of Way, the Structure Gauge and the Clearances as stipulated in the Specifications.
- g. The locations and Chainages are tentative and indicative only. It is the Contractor's sole responsibility to verify their precise nature and location before undertaking the Detailed Design.

(2) General Arrangement Drawings (GAD)

- a. The Employer's General Arrangement Drawings (GADs) are a set of reference drawings which shows the Employer's concept of each Permanent Works above, are indicative and for reference only. These shall be further developed by the Contractor as part of Detailed Design/ drawing as relevant and shall be coordinated with Other Contractors.

- a. The GADs as relevant to this package are included in the Part – 2, Section VII-3:Tender Drawings.

- (2) **General Drawings** – Containing the general map of the alignment route and the Site location map,

6.6 CONTRACTOR'S REVIEW OF EMPLOYER'S DESIGN & DRAWINGS

The Contractor shall review the indicative General Arrangement and other Drawings and suggest his modifications and improvements based on site conditions and as a result of the Simulation Study conducted by him and approved by the Employer.

6.7 VALIDATION OF DATA & ADDITIONAL SURVEYS

6.7.1 The Contractor shall verify the available data for adequacy and applicability. The Contractor shall plan and Program for the validation of the drawings and data provided by the Employer.

6.7.2 The Contractor shall conduct additional surveys if required as below:

- a. Survey for Earth Resistivity as appropriate to achieve the required earth value, touch and step potential.
- b. Electromagnetic Interference from AC traction currents and to mitigation measures of adjacent circuits and ensuring safety. Special precautions and preventive measures which may become necessary against EMI for any adjacent continuous metalwork such as fencing, wires and cables affecting safety to the public or to the circuits from induction effects of 2 x 25 kV, 50 Hz, AC traction currents or for foundation designs for the Traction Structures, passage of OHE through over line structures and tunnels, those affecting adjacent IR lines in operation or any other purpose as considered necessary. The Contractor shall carry out his own independent survey and inform the Employer of the results of such survey recommending the mitigation measures.
- c. The Contractor shall design and provide the mitigation measures for the entire installation to be provided by him. In regard to the mitigation measures to be taken on the installation of outside bodies and Indian Railways, the Employer shall decide the agency through which such mitigation measures shall be taken up.

6.7.3 The contractor shall conduct surveys as required for Contractor's Simulation Study under the scope of work specified in Particular specifications. Based on the final validation Survey and additional survey the contractor shall formulate a proper preliminary design parameters for finalizing the Detailed /Construction designs.

6.8 RESIDUAL & SUPPORTIVE WORKS TO DELIVER THE PERMANENT WORKS

- a. It shall be the Contractors responsibility to carry out all the residual/supportive works as essential to deliver the Permanent works and take precautions necessary to ensure that the survey works are accurate, accountable and secure.
- b. The Contractor shall ensure but not limited to performing all necessary calculations in a clear presentation of computations and results in order to facilitate verification by the Contractor himself and by the Engineer of the results arrived at. If any computer simulations have been performed the basis, formulae and

the constants adopted shall be indicated justifying their use.

6.9 DESIGN STAGES REQUIREMENTS

6.9.1 The principal requirements of the Design Phase are the production of

- Preliminary Design,
- Detailed Design,
- Construction/Installation Design and
- As Built Documents & drawings.

6.9.2 The Design Phase shall be considered complete upon the issue of a "Notice of No Objection" by the Engineer in respect of the last Detailed Design Submission which shall comprehensively and completely form the Detailed Design for the whole of the Works.

However, the Engineer reserves the right to review and satisfy for adequacy of design, the obligations and intended purpose of the design of the Works in compliance to the Contract.

6.9.3 A conceptual flow of the Design Stages and Review Procedure in the Design and Construction Phases is depicted hereunder:

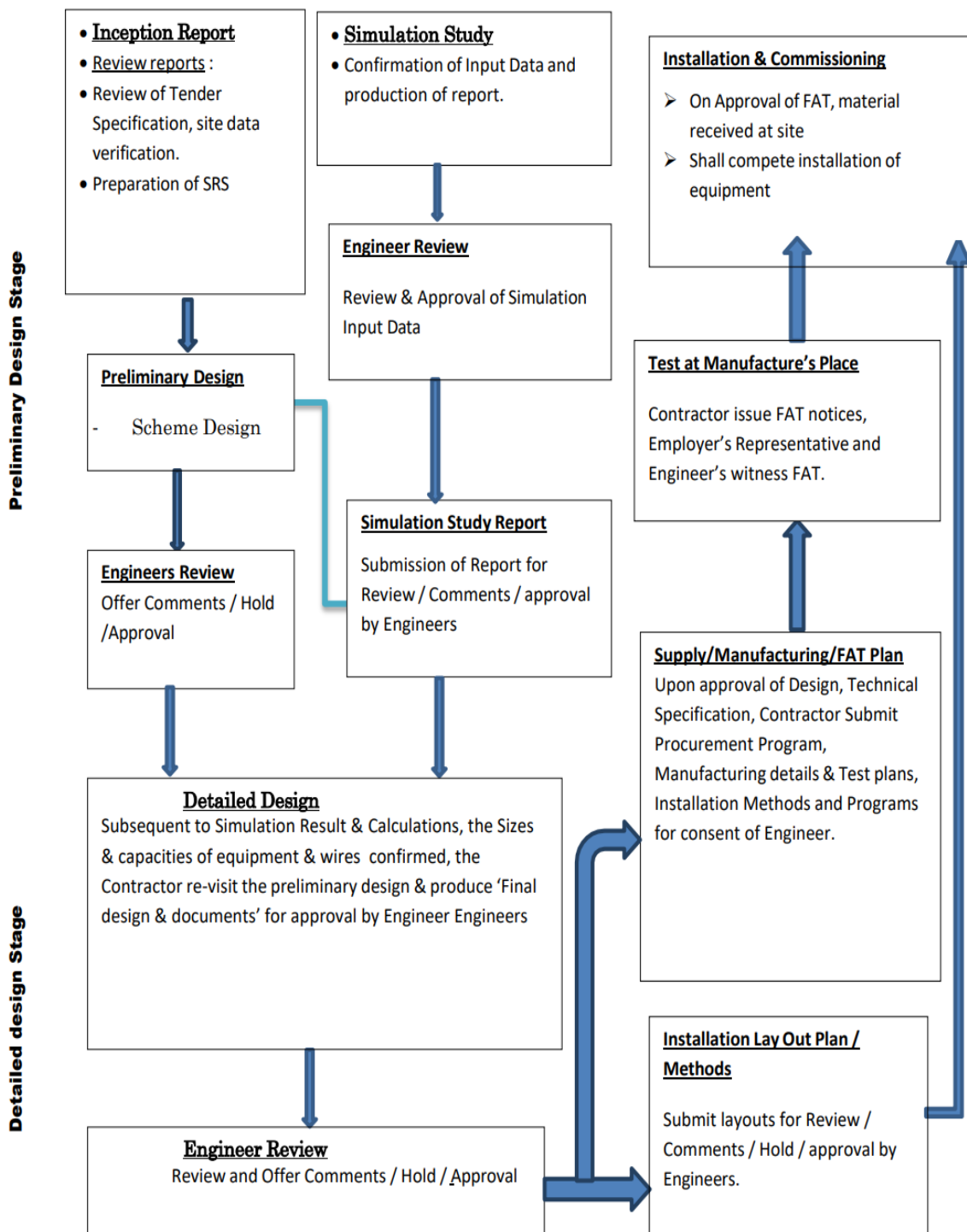


Fig – Design Submissions

6.9.4 Design submissions including Preliminary Design, Detailed Design, Construction / Installation Design, As-Built Documents shall be endorsed with a valid “Design Certificate” as specified.

6.10 INCEPTION REPORT WITH STUDY ON PS, GS AND STANDARDS

- 6.10.1 Within 42 Days from commencement date, The Contractor shall furnish an Inception Report for approval of the Engineer describing the Project Information, Scope of Work, Project Management Setup, Organization Chart with Key Experts, Project Manager, Communication Matrix, Site office, office for designer, Methodology to deliver identifying the Sub-systems, key activities, key performance parameters, key dates of submissions, document submission program and Initial Work Plan etc.
- 6.10.2 The Inception Report shall be sufficiently detailed to demonstrate the approach to design for the work under the Scope including but not limited to the main component equipment structures equipment specifications capacities and ratings of major equipment viz. Traction transformers, the Auto transformers, switchgear, conductor sizes their fittings; power supply installation, building required for housing the equipment and SCADA System, Electronic interlocking of major yards and Mobile train communication etc. so that all items necessary to develop the basic component designs and their assemblies, their installation and testing are provided.
- 6.10.3 The Contractor shall review all applicable data, criteria, standards, directives and information provided to him as the basis for design. Any apparent inconsistencies or erroneous information shall be brought to the attention of the Engineer as a Review Report a part of Inception report. Such information shall not alleviate the Contractor from his responsibilities under the Contract.

6.11 SYSTEM REQUIREMENT SPECIFICATIONS

- 6.11.1 Within 63 days of Commencement of Work, the Contractor shall prepare a System Requirement Specifications (SRS) as reproduced from PS in sequence as interpolated with Information/ provisions specified in GS, other contract documents or relevant Standard as numbered for each line. SRS will form as a minimum, operational, functional, performance and design requirements of the proposed system.
- 6.11.2 While the Para number Reference of original document will be retained, the source & Para reference of the content inserted shall also be mentioned in the Document.
- 6.11.3 The Document may identify or list the deliverables essential for RAM and Safety.
- 6.11.4 The System Requirement Specifications (SRS), serving as a means of system requirement management and the Contractor's top level design document, shall state all the requirements completely and unambiguously and how each requirement can be verified and validated.

6.12 PRELIMINARY DESIGN

6.12.1 Preliminary Design Stages

- a. The preliminary design stage, as a minimum, shall identify the function of each system, sub-system, equipment or other element within the overall SRS and specify the relationships and interfaces between each element of the system including the systems of the interfacing elements of other Contractors.
- b. Equipment and interconnection specifications, with supporting calculations, shall be developed at this stage. Submissions shall clarify and confirm as necessary all technical aspects of all interfaces with other elements of contractor's overall design and of any interfaces with systems of other contractors.

- c. The Contractor shall submit with each submission a compliance matrix identifying the Cross-references of SRS and submit a Design Verification Table (DVT).
- d. Ergonomics of the designed system shall be verified at this stage.
- e. Mock-ups/prototypes shall also be developed during this stage.

6.12.2 Preliminary Design Report

- a. Within 90 days after the Commencement Date, the Contractor shall submit the Preliminary Design Report as described herein and as further detailed in Employer's Requirements.
- b. The Preliminary Design Report shall contain the following but not limited to
 - i. Project Information,
 - ii. Reproduced the scope of work,
 - iii. Environment & Boundary conditions,
 - iv. Functional requirement,
 - v. Operational & Maintenance requirement,
 - vi. Assumptions,
 - vii. Design criterion,
 - viii. Standards and Reference Documents,
 - ix. The System description identifying measure subsystem, equipment and components.
 - x. Engineering studies and comparative evaluations on the various systems adopted in past for other projects worldwide with techno economic considerations and recommendations,
 - xi. The System's Application Duty Requirement,
 - xii. Design Criterion, RAM, safety and life of each components of the Train and input data document essential for Traction Simulation Study to be carried out as per HRIDC's traffic plan of the route.
 - xiii. Traction Simulation Study Results for the electrical portion of the work.
- c. The Contractor shall submit the Systems & Sub Systems Planning Report to the Engineer for review as part of Preliminary Design Report.

6.13 DESIGN MANUAL FOR SYSTEM WORKS

- a. Soon after finalization of rating of components and preparation of Employment schedules required of the Construction Drawings, the contractor shall prepare and submit Design Manual to enable review of the design by the Employer's design team.
- b. The Design Manual shall be produced so that it can be used by those involved in the preparation or review of the design of the Works as a comprehensive reference text and efficient working document.
- c. The Design Manual shall refer to all material, codes and standards used making clear their specific applications.
- d. The Design Manual shall incorporate all design requirements which are relevant to and govern the design including conformance to Standards, codes, Rating,

Application Duty requirement, Max temperature, Design Life, Modularity, Redundancy, Reliability, Factors of Safety, Limiting Factors of Electrical Clearances, noise, pollution etc.

6.14 DETAILED DESIGN STAGE

- a. During the preparation of the Detailed Design, the Contractor shall in particular ensure that:
 - i. All standards and regulations relevant are compiled;
 - ii. Complete all Calculations and Analysis;
 - iii. The designs meet the application duty requirement;
 - iv. Safe design;
 - v. The system designs meet the reliability, availability, and maintainability obligations as per best of industry standards;
 - vi. All main and other significant elements are delineated;
 - vii. All protocol of tests and trials, all selection of material and equipment are complete;
 - viii. Assess and take full account of the effect on the Works of the proposed methods of construction, installation, testing and commissioning for permanent and temporary works.
 - ix. Complete the validation of all the data provided by the Employer including all the additional surveys, investigations and testing as considered necessary by the Contractor to develop the Detailed Design of the Works in accordance with the Contract.
 - x. Draw up a set of the Construction Reference Drawings (CRD) as summarized in Requirements for Submission of Documents and Drawings.
- b. Based on the Contractor's Technical proposal and Preliminary Design as consented by the Engineer, the design of the Works shall be fully developed in detail as a part of the 'Detailed Design' by the Contractor.
- c. The 'Detailed Design' shall be prepared in accordance with the requirements of :
 - i. Train operation requirement as identified in HRIDC's Business Plan & as indicated in the Employer's Requirement;
 - ii. Particular Specifications including Design Criteria, Codes, Standards and Manuals as applicable on Indian Railways and applicable regulations / legislation in India and
 - iii. Existing International norms/standards wherever required.
- d. The 'Detailed Design' documents and drawings as developed and updated shall be submitted to the Engineer for consent and issue of a Notice of No Objection.
- e. Engineering studies and comparative evaluations shall be performed to ensure that the designs incorporate features to achieve optimum performance in consonance with economy of all elements.
- f. The Detailed Design shall include the Construction Reference Drawings, the Works Specification, the Detailed Design Report, the Construction Method Statement and all other contents of the Detailed Design Submittals as

summarized in 'Employer's Requirements -- Part 2, Section VII-2: Particular Specifications.

- g. The Contractor shall divide the Works into Works Segments in accordance with the "Definition of Works Segments" given in 'Basic Design Philosophy and Requirements for Design' of Employer's Requirements - Particular Specification and shall identify the Works Segments in the Works Program and the Design Submission Program.
- h. The Contractor shall sub-divide all the Design into Design Packages which shall be identified in the Design and Certification Submission Program. Each Design Package shall be a clearly and easily identifiable parts of the Design and shall address the design requirements as described herein. The Design Packages shall facilitate the review and understanding of the Design as a whole and shall be produced and submitted in an orderly, sequential and progressive manner to suit the manufacture/supply, installation, testing and commissioning sequence and the Works Program.
- i. Separate Design Submissions may be prepared for those major elements to be procured through sub-contract which include design. Where such work is to be procured by the Contractor on the basis of outline design, design briefs and performance specifications, such documents may be submitted as Detailed Design Submissions.
- j. Upon completion of Internal Authorization Process, as specified in 'Quality Assurance Requirements' of this Employer's Requirements, the Contractor shall submit the Detailed Design as described herein, to the Engineer for consent and issue of a "Notice of No Objection".
- k. Upon issue of the "Notice of No Objection" in respect of the Detailed Design Report, the Contractor shall complete the design in all respects and produce 'Good For Construction Drawings' (GFC).
- l. The issue of separate NOCs for such sub-divisions shall be conditional upon the Contractor having demonstrated, to the satisfaction of the Engineer, the adequacy of the ratings of the equipment safety, suitability for application duty including its effects on other Contracts for the whole Works Segment has been fully accommodated in the Detailed Design Package to ensure reliable and safe operations of the completed system.
- m. The Contractor shall provide to the Engineer two original full and latest editions of the publications / Technical Standards including the Codes and Standards and other documents that the Contractor proposed to use for carrying out the Detailed Designs, including other communications between Engineer and the Contractor relevant to this Contract as part of the Inception Report. These publications / documents shall be for the sole use of the Engineer and upon completion of the works shall become the property of the employer.
- n. The Temporary Works as essentially needed shall also be identified as a separate Works Segment and the design of those shall be proposed by the Contractor early enough to have sufficient discussions on Engineering and procedural issues with the Engineer so as to meet the intent of the Employer's Requirements. The Contractor shall submit the agreed design of the Temporary Works as part of the Detailed Design to the Engineer for consent.

6.15 DESIGN REQUIREMENTS DURING CONSTRUCTION PHASE

6.15.1 The principal requirements during the Construction Phase are the production, submission and seeking consent of the Engineer for the "Good For Construction" Drawings, Construction Design, the As-Built Documents and the O&M Manuals.

6.15.2 All construction phase drawings and documents shall be revised, upgraded, detailed and integrated in the Construction Design Package.

6.15.3 The Contractor shall fully verify and endorse all Drawings and documents with Design Certificate during Construction Design Package through the Internal Authorization Process as specified.

6.15.4 Construction Design

- a. The Construction Phase for the whole or a part of the Works shall commence immediately upon the issue by the Engineer of a 'Notice of No Objection' in respect of the relevant Detailed Design Submission, subject to the availability of the Site in accordance with the agreed Program for site hand over by the Employer. Such "Notice of No Objection" may be issued by the Engineer in respect of a Detailed Design Submission covering a major/ distinctive part of the Works/ activity in accordance with the Design Submission Program. However, construction shall not be commenced until the appropriate Construction Reference Drawings and other documents forming the Construction Design Package have been endorsed as "Request for Construction" through the Contractor's Internal Authorizing and Quality Assurance Process.
- b. The Construction stage drawings shall be coherent and complete set of Document in line with the preliminary Design Document along with a copy of the NOC issued previously by the Engineer for the relevant portion, shall be submitted to the Engineer. The detailed design reference shall also be incorporated in such submissions
- c. Detailed Design Drawings shall form part of the Drawings to be used for installation purposes and construction shall be strictly in accordance with the relevant Design Stage.
- d. Only those drawings and documents that have been endorsed and certified and have received consent as above shall be issued to the Site
- e. The Construction Phase shall include the completion and submission of the Construction/Installation Design and the As-Built Documents
- f. The design of the permanent and temporary works of this contract shall be carried out in accordance with the Contractor's Quality Assurance Plan in compliance with the Employer's Requirements.
- g. the Contractor shall produce the respective Construction Design Package which shall include, but not limited to,
 - i. The 'Good For Construction Drawings',
 - ii. Updated construction stage related Project Management Plans;
 - iii. The updated Works & Material Specifications;
 - iv. Updated Technical Drawings;
 - v. Updated detailed design Report;
 - vi. Method Statements/ work procedures/ construction sequences;

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- vii. The Interface Drawings related to the other Construct Contracts;
- viii. Field change Drawing & Design, if any.
- h The Good for Construction Drawings and Construction Reference documents shall include site sketches, dimensioned drawing, fabrication and shop drawings, erection plan and sequences etc.
- i Construction stage related Project Management Plans as detailed this GS and Particular Specification shall be updated and endorsed by the Contractor through the Contractor's Internal Authorizing Process as being in accordance with the Technical Design for which the Contractor has received the "Notice of No Objection".
- j Construction stage Works & Material Specifications as detailed in this GS and Particular Specification shall be updated and be endorsed by the Contractor through the Contractor's Internal Authorizing Process as being in accordance with the Technical Design for which the Contractor has received the "Notice of No Objection".
- k The Construction Design and Construction Technical Drawings including updated Works Specifications / Method Statements etc. shall be derived directly from the Detailed Design as approved by the Engineer including the incorporated changes as commented by the Engineer attached to the Notice of No Objection.
- l The Working/ Fabrication Drawings and the Construction Practicing Documents shall be prepared to facilitate construction to meet the required workmanship as well as technical requirements.
- m The updated Method statements shall be prepared to check and monitor the Works in terms of *ESHS* requirements described in Project *ESHS Plans* and Quality Assurance.
- n Upon the Internal Authorization Process, the Contractor shall submit the Construction Design Package as the "Request for Construction" to the Engineer for consent and issue of a Notice of No Objection. Upon receipt of the "Notice of No Objection" or "Notice of No Objection With Comments", the Contractor shall endorse the original paper drawings in respect of the Working Drawings as "Good For Construction" as per the Internal Authorization Process and issue.
- o If the Engineer so requires, the said endorsed original paper drawings shall be re-submitted to the Engineer, who shall, if has no objection to the contents of the re-submission, further endorse the original paper drawings by stating that he has no objection to the proposed Working Drawings. On endorsement by the Engineer, the original drawings will forthwith be returned to the Contractor as Working Drawings to be issued to Site.
- p The "Good For Construction Drawings" and the Working Drawings shall be used for construction purposes and only those drawings and documents that have been endorsed and certified through the procedure and have received "Notice of No Objection" as above or those that the Engineer has expressly stated as not requiring his endorsement shall be issued to the Site.
- q The Construction of the Works shall be strictly in accordance with the Construction Design Package, for which "Notice of No Objection" has been issued by the Engineer and "Good For Construction" drawings has been issued as per the authorization process detailed as above.

- r The Construction Design Package may be divided into multiple submissions for different Work Segments as required to be consented by the Engineer. In such a case:
 - i. Construction Design and Drawings in respect of each Work Segment shall be submitted for the entire scope of work.
 - ii. All Submittals which are commonly applicable to the subsequent submissions shall be submitted in the initial submission and each submission shall include correlated and interdependent submittals.
 - iii. All the divided Construction Design Submissions shall be integrated and compiled into one package at the time when the final submission is made as the Construction Design Package.
- s If the Contractor identifies the need for any change to the design due to site conditions or any other reason, the Contractor shall produce a Design Change Notice or Field Change Notice in accordance with procedures as specified.
- t The Contractor shall submit the Construction Design and Drawings for a particular work to the Engineer at least 3 months but not more than 6 months prior to the planned / scheduled date of commencement of that particular work.

6.15.5 Design Changes And Variation Procedure

a. Design Changes

In the event that the Contractor identified a problem or other cause for a change in his design after the Construction Design has been submitted and consented by the issue of Notice of No Objection during the Construction Phase, the Contractor shall propose, in writing the design change through, a solution and procedure either a Field Change Notice (FCN) or a Design Change Notice (DCN) or a Variation Notice (VN) depending on the severity of the change within the Contract.

A major design shall warrant a Design Change Notice and These Design changes shall go through the full process of the Design Review Procedure. Whenever site changes may be agreed at site level by producing a Field Change Notice, the Engineer shall decide whether the proposal shall be DCN or FCN.

b. Design Variation

Design Variation including Value Engineering may be initiated at any time prior to issuing the Taking-over Certificate for the Works. A design variation shall not result in the omission of any of the Works.

6.16 AS-BUILT DOCUMENTS

- 6.16.1 The Contractor shall maintain all records necessary for the preparation of As-Built Documents. The Contractor shall prepare and submit As-Built Drawings and the Records which shall become the contents of As-Built Documents on Engineer's agreement. Within seven days of commissioning of any Sub-System, the Contractor shall submit 6 sets of verified design documents. Prior to the issue of the Taking-Over Certificate and in accordance with the Conditions of Contract Clause 5, the Contractor shall prepare As-Built Drawings and Records which, subject to the Engineer's agreement, shall become the contents of As-Built Documents.
- 6.16.2 As-Built Drawings shall be a full set of the latest revisions of the Construction Technical

- Drawings, which are updated to incorporate all variation orders, Design Change Notices and Field Change Notices as well as Working Drawings as necessary to convey a full and true record of the as-built condition of the Works. As-Built Drawings shall show all changes from the Preliminary/Final Detailed/Construction Designs and Drawings, all construction deviations and all other features relevant to the future maintenance and management of the Railway and its facilities.
- 6.16.3 As-Built Drawings shall be endorsed by the Contractor as true records of the constructed Works.
- 6.16.4 As-Built Records shall include the recorded photographs as being consistent to Progress Reports in the Conditions of Contract.
- 6.16.5 As-Built Records shall be verified and endorsed by the Contractor through the Internal Authorization Process, as specified in 'Quality Assurance' of this Employer's Requirements, as true records of the construction of the Works.
- 6.16.6 As part of the As Built Documents, the Contractor shall maintain all records necessary for the completion and commissioning of the project. These records shall consist of as a minimum but not limited to the following:
- a. The list of implemented work according to activities, locations/ places;
 - b. Used Material – type, Name of Material, name of manufacturers along with batch number, Date of Manufacturing, locations/ places and quantities etc;
 - c. Installation drawing complete with route, location plan, Mounting details and cross sections of Equipment & Components;
 - d. 'Control' and 'Status' monitoring Cable index, control logics, schematics and wiring diagrams as applicable';
 - e. Electrical and mechanical clearances including Clearance of track side equipment (e.g. OHE mast, Signals, Location Boxes etc.) in millimeters from Centre line of adjacent track(s) shall be verified and painted on the relevant equipment;
 - f. Any other record as required by the Engineer / Employer;
 - g. Records related with acceptance of change orders and
 - h. Construction Diary.
- 6.16.7 The Contractor shall prepare and submit the Operation and Maintenance Manuals (O&M Manuals) as part of the As-Built Documents.
- 6.16.8 The O&M Manual shall include the details of each system, subsystem, equipment / components of the Work as essential along with performance benchmarks of reliability, availability and Maintainability. The Requirement for the Operation and Maintenance Manuals (O&M Manuals) is further detailed in the this GS under different section in accordance with the Specifications and in sufficient detail for the Employer to operate, maintain, dismantle, reassemble, adjust and repair the Works.
- 6.16.9 The As-Built Documents shall be submitted to the Engineer for consent and issue of a "Notice of No Objection".
- 6.16.10 All the As Built Drawings and Records shall be submitted prior to the commencement of the Trial Runs. If as a result of tests and trials the "As built Drawings" need to be revised, these shall be also carried out. The Work shall not be considered to be completed for the purposes of issue of "Taking over Certificate" until these documents and manuals have been submitted and accepted by the Engineer.

6.17 DESIGN INTERFACE WITH OTHER CONTRACTORS

6.17.1 Other Contractors

- a) The Contractor shall fully coordinate the design of the Works with the design of the other Contractors and shall follow the interfacing requirements as detailed in 'Interface Matrix'.
- b) Those Works, which are required to be executed by the Other Contractors, shall be fully coordinated and integrated and shall be provided throughout the Design development and the results shall be recorded and summarized in the Combined Service Drawings (CSD) and the Interface Drawings and Report on Other Contractors as part of the Detailed Design.

6.17.2 External Related Parties

- a) The Contractor shall fully coordinate the design of the Works with all relevant bodies and entities, in particular government authorities, departments and regulatory bodies, public utility companies, Power Supply Authorities, Indian Railway, consultants and contractors of adjacent projects whether ongoing or planned, as advised by the Engineer. The Contractor shall identify all such related parties in his Interface Management Plan (IMP) and other relevant requirements detailed the Particular Specification to the Employer's Requirements.
- b) Co-ordination with Indian Railways for HRIDC's General arrangement of OHE layout and their proposed Design in respect of those in vicinity of the existing structures of Indian Railways shall also be required to get approval from Indian Railways through Employer in addition to the consent by the Engineer. The Contractor shall be required to submit one additional copy of all his GADs / span arrangement and Design of all such structures to the Engineer for onward submission to Indian Railways.
- c) The Employer shall co-ordinate seeking the approval from Indian Railways, however, the Contractor shall facilitate the Engineer / Employer in seeking the approval from Indian Railways including but not limited to providing clarifications / additional data, attending meetings etc. as required.

6.18 DESIGN SUBMISSION PROCEDURE

6.18.1 In the case of submissions subsequent to the Technical Design, the Design Data shall be in accordance with the Employer's Requirements and the Technical Design.

6.18.2 The Contractor shall submit to the Engineer all the Designs and relevant Design Data together with the Design Certificates, on or before the respective dates for submission shown on the Design Submission Program or the Works Program detailed in Chapter-4 of this document. In the event that a resubmission of Design / Design Data is required, such resubmission shall be made as soon as practicable after the receipt of the relevant statement of objections. All submissions of Design Data shall include the copies as stipulated in the Employer's Requirements.

6.18.3 Following receipt of a submission of Design and Design Data, the Engineer shall, within the period specified in Design Submission Program respond as per the procedure defined therein and issue "Notice of No Objection" or "Notice of No Objection with Comments" or "Notice of Objection with Comments" as the case may be. The Contractor shall comply with the requirements accordingly as specified therein.

6.18.4 The issue of a 'Notice of No Objection' in relation to any submission of Design shall be

entirely without prejudice to the review of subsequent submissions of Design or to any subsequent request for a Contractor's Variation, and shall not bind the Engineer in any manner Dedicated whatsoever when deciding whether to accept or not to accept the issue.

- 6.18.5 The Contractor shall obtain all required and /or statutory approvals, prior to the submission of all Design and shall ensure that all required approvals have been obtained.

6.19 DESIGN REVIEW PROCEDURES

- a. The designs for all stages shall be submitted for review and consent to the Engineer. The form and the procedures adopted in the Contract shall not release/remove/ exonerate the Contractor's responsibility towards the design under this contract.
- b. The issue of a 'Notice of No Objection' will be without prejudice to the issue of any future Notices.
- c. Supplemental, supporting information to the design submission under review may be requested by the Engineer. The Contractor shall supply such information within the time specified by the Engineer.
- d. All submissions shall be accompanied by six (6) original copies of "Design Certificate" format as per Appendix-3.

6.20 DOCUMENT & DRAWINGS SUBMISSION PROCEDURE

The Contractor's Technical Proposals shall be amplified during the design stages. The following process of document submission shall be generally followed:

- a. The Contractor shall submit drawings and documents, as required by the Contract, to the Engineer in accordance with the Design Submission Program meeting the requirements.
- b. The Construction Design submittals shall be made sufficiently before the Works are to be carried out to give the Engineer reasonable time to examine the drawings or other documents and to prepare comments within the response time.
- c. Where the consent / Notice of No Objection from the Engineer is required, the Engineer shall notify the Contractor in writing of his decision within stipulated time of 28- days.
- d. the Engineer has reasonable cause for being dissatisfied with the submissions made by the Contractor, the Engineer shall inform the Contractor in writing to make such amendments thereto as the Engineer may considerer necessary. The Contractor shall make such amendments at no additional expense to the Employer and shall resubmit the amended documents for Engineer's consent.
- e. Within 7 days of notification of the Engineer's consent / "Notice of No Objection" or "Notice of No Objection with Comments", the Contractor shall provide the Engineer with the type and numbers of sets of the relevant drawings and / or documents as stipulated in the Employer's Requirements for further execution of the process.
- f. Should it be found at any time after notification of consent / "Notice of No Objection" / "Notice of No objection with Comments" (as the case may be)

that the relevant drawings or documents do not comply with the Contract or do not agree with drawings or documents in relation to which the Engineer has previously notified his consent / "Notice of No Objection" / "Notice of No objection with Comments" (as the case may be), the Contractor shall, at his own expense, make such alterations or additions as, in the opinion of the Engineer, are necessary to remedy such non-compliance or non-agreement and shall submit all such varied or amended drawings or documents for the consent of the Engineer.

- g. Errors, omissions, ambiguities, inconsistencies, inadequacies and other defects shall be rectified by the Contractor at his own cost and the acceptance by the Engineer of the Manufacture and Construction Documents shall not amount to any waiver and shall not relieve the Contractor of his obligations under the Contract.
- h. No examination by the Engineer of the drawings and / or documents submitted by the Contractor, nor any consent / "Notice of No Objection" / "Notice of No objection with Comments" (as the case may be) of the Engineer in relation to the same, with or without amendment, shall absolve the Contractor from any of his obligations under the Contract or any liability for or arising from such drawings or documents.

6.21 CALCULATIONS

- 6.21.1 The Contractor shall submit all the drawings accompanied with Detailed report, calculations, supportive documents, references and evidences of previous examples where in such a method has been used.
- 6.21.2 All the required calculations shall be submitted together with the respective Design Package submissions unless stated otherwise.
- 6.21.3 A comprehensive set of calculations for the whole of the Design including that for simulation study in the form acceptable to the Engineer shall be submitted by the Contractor to the Engineer for consent as part of the relevant submittals.
- 6.21.4 Should the design of the Works be revised, the Contractor shall prepare and submit revised calculations as well as the revised designs and drawings and recall all previous versions circulated in past.
- 6.21.5 The Engineer shall require the Contractor to submit and install one copy of all the applicable software as used by the Contractor for the Design excluding the train and traction Power Simulation Computer Program, duly licensed in the name of Employer and the Engineer and in accordance with Employer's Requirements of this specification including in-house software program / worksheets developed by the Contractor, computer input and program logic prior to the acceptance of any computer output. The Contractor shall submit the same to the Engineer without any additional cost.
- 6.21.6 Contractor shall submit all calculations necessary to support proposals relating to the construction methods.

6.22 CONTRACTOR'S WARRANTY OF DESIGN

- 6.22.1 The Contractor warrants that the Contractor's design shall be in accordance with General Obligations Conditions of Contract and meets the Employer's Requirements and Specifications provided by the Employer and is fit for the purpose thereof. Where there is any inadequacy, insufficiency, impracticality or unsuitability in or of the Employer's Requirements and Specification or any part thereof, the Contractor's design shall take

- into account, address or rectify such inadequacy, insufficiency, impracticality or unsuitability at Contractor's own cost.
- 6.22.2 The Contractor shall indemnify the Employer against any damage, expense, liability, loss or claim, which the Employer might incur, sustain or be subject to arising from any breach of the Contractor's design responsibility and /or warranty.
- 6.22.3 The Contractor further specifies and is deemed to have checked and accepted full responsibility for the Contractor's part of the design notwithstanding:
- a. That such design may be or have been prepared, developed or issued by the Employer which has been checked by the Contractor, any of Contractor's consultants, his sub contractor's and/or his qualified personnel/persons or cause to be prepared, developed or issued by others.
 - b. Any warranties, guaranties and /or indemnities that may be or may have been submitted by any other person.
 - c. That the same have been accepted by the Engineer.
- 6.22.4 The Contractor shall conform to the provision of any statute relating to the Works and regulation and bye-laws of any local authority and of any water and lighting agencies or undertakings, with whose system the work is proposed to be connected and shall before making any variation from the drawings or the specifications that may be necessitated by so confirming give to the Engineer notice specifying the variation proposed to be made and the reason for making the variation and shall not carry out such variation until he has received instructions from the Engineer in respect thereof. The Contractor shall be bound to give all notices required by statute, regulations or bye-laws as aforesaid and shall pay all fees and taxes payable to any authority in respect thereof. Nothing shall be payable by the Employer in this regard.
- 6.22.5 The Contractor shall ensure compliance of provision of all laws of land in force and enacted from time to time and ensure compliance of the regulations or bye-laws of any local body and utilities. The ignorance of rules, regulations and bye-laws shall not constitute a basis for any claim at any stage of work. The Contractor shall arrange necessary clearances and approvals before the work is taken up.
- 6.22.6 The Design Warranty shall be submitted by the Contractor in format provided at Chapter 15: Annexure 3 – Design Certificate of this GS.

(End of Chapter 6)

CHAPTER 7 - WORK AREA MANAGEMENT

7.1 WORKS AREA

- 7.1.1 The Contractor shall divide the Site into separate Works Areas/Railway Envelopes and shall elaborate a schedule for the time periods of the availability of these areas for his contract performance. This should be synchronized with the Schedule of access to Site provided in Section IX: Part A – Contract Data of Particular Conditions of Contract (PCC), Part 3 of Tender document taking account of the Contractor's co-ordination and integration responsibilities with the interfacing contractors.
- 7.1.2 The Contractor shall indicate the exact nature of the various Works Areas and the extent of works to be carried out prior to the execution of the permanent systems works or making use of the area as working space and/or for temporary Site facilities.
- 7.1.3 The schedule as mentioned above shall include, but not limited to, the following data:
- a) Indication of the Works Areas;
 - b) Description and intended use of the Works Areas;
 - c) The start and the end date of the availability of the Works Areas, required by the Contractor;
 - d) The start and the end date of the periods in which the Contractor is to allow the Works Areas to be accessed by interfacing parties.
- 7.1.4 The information shall be submitted as part of the Contractor's preliminary design and shall be subject to agreement by the Employer and approval by the Engineer.
- 7.1.5 On the basis of the approved information, the Contractor shall submit the proposal for the use and the occupation of the Works Areas, such submissions being at least fifty six (56) days prior to the program use of the specific Works Area.
- 7.1.6 Prior to the scheduled dates for returning of any of the Works Areas for subsequent use by an interfacing party, the Contractor shall carry out the following activities:
- a) Construct all Permanent Works within the Works Area, to the extent as defined in the Detailed Design and in accordance with the requirements of the Contract;
 - b) Reinstatement of the area to the same condition as it was taken over;
 - c) Form the area to the approved lines and levels and carry out such other works as may be required by the provisions of the Contract;
 - d) Remove all rubbish, debris and other material; and
 - e) Carry out and record jointly with the Engineer and interfacing contractors a condition survey of the area.
- 7.1.7 Restrictions on the timing of occupation so as to avoid affecting operation will be made.
- 7.1.8 The interfacing parties shall be required to vacate the Works Areas at least 28 days before the due date for handing over back of the Works Areas by the Contractor to the Employer, thus allowing the Contractor to clear and reinstate the works areas in accordance with the Contract.
- 7.1.9 Entry to and exit from the Site shall be controlled and shall be only available at the locations for which the Engineer has given his consent.
- 7.1.10 The Contractor shall ensure that access to every portion of the Site is continually available to the Employer and Engineer.

- 7.1.11 Other contractors engaged for project execution shall also be allowed to use the temporary facilities so created by him to access the Site without any consideration.
- 7.1.12 Employer will take over the entire stretch as per General Conditions of Contract.
- 7.1.13 The Contractor shall be responsible for ensuring that any access or egress through the Site boundaries are controlled such that no disturbance to residents or damage to public or private property takes place as a result of use of such access or egress by its employees and sub-contractors.

7.2 STANDARD ENGINEERING CONDITIONS

The following standard engineering conditions apply to all Works Areas:

7.2.1 Forming of Areas

- a) The Works Areas shall be formed to the levels shown on the drawings. No levels shall be amended without prior consent of the Engineer.
- b) The Works Areas shall be surfaced in a manner agreed with the Engineer, compatible with their intended use and in particular, footpaths and roadways connecting facilities shall be provided.
- c) Measures shall be taken to the satisfaction of the Engineer to ensure all areas are properly drained and kept free of static water.

7.2.2 Roads and Parking

- a) Space shall be provided within the Works Areas for parking, loading/unloading and maneuvering of motor vehicles.
- b) Any damage caused by the Contractor to the adjoining public roads and fixtures and properties (public or private) shall be made good to the satisfaction of the Engineer and its owner.

7.2.3 Drainage and Sewerage

- a) All storm or rainwater from the Work Areas including any access roads thereto shall be carried to the nearest stream course, which has the necessary capacity, catch-pit, and channel or storm water.
- b) All temporary and permanent Works shall be carried out in such a manner that no damage or nuisance are caused by storm water or rain water to the Site and adjacent property.
- c) Damage or obstruction caused to any watercourse, drain, main or other water installations within or adjoining the Works Areas shall be made good to the satisfaction of the Engineer.
- d) Treatment and disposal of sewage and wastewater from the Works Area shall be provided to the satisfaction of the Engineer following the ecological requirements.

7.2.4 Buildings

- a) No permanent structures other than those required for the Permanent Works shall be permitted in the Works Areas.
- b) The Contractor, as required, for all temporary buildings, shall provide requisite electricity, water, telephones and sewerage facilities.

7.2.5 Pedestrian Access

Any accesses or passing through the Works Areas shall be maintained in a usable condition at all times to the satisfaction of the Engineer including lighting, signing and guarding.

7.2.6 Fencing and Signboards

For executing the work adjacent to running traffic areas, the Contractor shall erect fences and gates around its areas of operations to prevent accidents as well as post competent flagmen.

7.3 POSSESSION OF IR TRACKS

7.3.1 General

- a) The Contractor shall comply with the traffic block (Possession) management system operated by Indian Railways (IR).
- b) The person appointed by Contractor shall coordinate with IR and the CST Contractors and shall act as the traffic block coordinator for the Contractor.
- c) The person appointed must have experience of IR operations and must be fully aware of IR rules and regulations related to possession of track for construction of railway works in accordance with IR regulations including meeting the Competency requirements as stipulated by IR.

7.4 POSSESSION PERIODS

- (1) The Contractor may use possession(s) on the line for execution of works as per approved plan following strict safety procedures.
- (2) Line closures may be agreed subject to IR approval.
- (3) The Employer gives no warranty that line closures and possession periods will be available during the period of the Works.
- (4) The Employer will however provide any assistance necessary to the Contractor to enable him to obtain the line closures and possessions required by him for the Works but will not be responsible if any Possession requests are refused by IR.
- (5) The Contractor shall prepare technological and organizational schedule for construction which shall include the work times in the weekends and during the dark part of the day.
- (6) The Contractor shall submit his requests for 'possessions' at least fourteen (14) days earlier and inform IR at least 48 hours earlier if he is not able to use the permitted 'possessions'.

7.5 TEMPORARY WORKS

The Temporary works are detailed in Appendix—4.

7.6 REQUIREMENT FOR CONSTRUCTION

The Requirements for Construction are detailed in Appendix-5.

(End of Chapter 7)

CHAPTER 8 - SUPPLY, INSTALLATION, TESTING & COMMISSIONING

8.1 GENERAL

- 8.1.1 These Employer's Requirements establish the overall procedure for the Contractor to follow for the Works that is related to the components manufactured off-site and supplied for installation in the Permanent Works. These requirements relate to their manufacturing, procurement, delivery, testing and installation in the system and associated activities.
- 8.1.2 The Contractor shall establish procedures and controls that govern the procurement/manufacturing off-site of material/equipment/ components required for the work and supply them for construction/installation, assembling and wiring in the Permanent Works.
- 8.1.3 The Contractor shall submit a comprehensive Testing Plan & Program for the project to the Engineer for his consent.
- 8.1.4 Type Test shall be performed by the Contractor and shall be witnessed by Employer's Personnel/Representative and / or the Engineer.
- 8.1.5 Factory Acceptance Test including stage inspection if required shall be performed by the Contractor and shall be witnessed by Employer's Personnel/Representative and/ or the Engineer.
- 8.1.6 Approval for witnessing Type Test shall be communicated by the Engineer to the Contractor after obtaining consent from the Employer.
- 8.1.7 The material delivered to the Site and offered for Inspection shall be manufactured normally not earlier than one (1) year and their guarantee period shall cover the Defects Notification Period. However, the specified period of Manufacturer's Warranty shall commence from the date of commissioning of the Work and all the manufacturer's Warranties shall be in the name of the Employer.
- 8.1.8 All material used for permanent work shall be as per the Specifications (SRS) and SOGP as approved by the Engineer.
- 8.1.9 Manufacturing and testing of various equipment, components and fittings shall be as per approved Technical requirement, SOGP etc.

8.2 MANUFACTURING

8.2.1 Management

The Contractor shall establish procedures and controls that govern the procurement, integration, manufacturing and testing, quality assurance and delivery of plant & equipment, manufactured items and spares to be supplied under the Contract. The Contractor shall submit Procurement Management & Manufacturing Plan and Quality Assurance Plan to the Engineer for his consent.

8.2.2 Procurement and Subcontract Management

The Contractor's Management Systems and Procedures shall incorporate procedures for material procurement and sub-contracting, sufficient to assure technical, administrative, quality and contractual controls consistent with those under this contract. The Contractor's management system shall be auditable for material sources, lot numbers, serialized equipment, etc. Sub-contract amendments shall be effected whenever contractual changes are made bi-laterally by the parties involved subject to consent of the Engineer.

8.2.3 Manufacturing Management

The Contractor's Quality Assurance Plan to control the Manufacturing quality shall contain:

- (1) A brief description of all inspection & Hold points and test points in correlation with the Program Schedule;
- (2) A list of all manufacturers, and sub-contractors for supply.
- (3) A delivery schedule of each item of equipment to match installation plan.

8.3 TESTING

A comprehensive Testing Program submitted by the Contractor shall include complete equipment, their subsystems and components and material to ensure conformance with the specifications. The Testing Program shall be subject to the consent of the Engineer. The purpose of the comprehensive Testing Program shall be to:

- (1) Substantiate design and performance characteristics;
- (2) Ensure operational compatibility;
- (3) Complete equipment verification and acceptance requirements; and
- (4) Complete all reliability, maintainability and safety demonstration requirements.
- (5) Testing shall comply with the requirements as specified in this Employer's Requirements

Unless otherwise agreed, all tests shall be witnessed by Employer's Personnel/Representative and / or the Engineer & recorded. An appropriate format for Test Schedule(s) and Procedure(s) including the details of testing equipment shall be submitted to the Engineer for approval. All tools & instruments for carrying out the tests shall be arranged by the Contractor to the satisfaction of the Engineer. Test results will be witnessed and signed by the Contractor and the Engineer and/or Employer's Personnel/Representative.

8.4 QUALITY ASSURANCE AND CONTROLS

8.4.1 The Contractor's management systems shall emphasize quality assurance and controls and shall be based on ISO 9001-2008 standards. The Procurement, supply and manufacturing and Quality Assurance Plan together with the Comprehensive Testing Program shall adequately ensure an acceptable level of quality of the Items manufactured and supplied. The concept of total quality assurance shall be based on the principle that quality is a basic responsibility of the Contractor's organization shall be evidenced by:

- a. Producible and verifiable designs;
- b. Firm procurement and job performance specifications;
- c. Firm procedures for transmission of information and data to sub-contractors and ensuring their compliance;
- d. Adequate testing to ensure repetitive product conformity to design requirements; and
- e. Total Program of surveillance and verification of physical performance and configuration accountability.

8.4.2 The Contractor shall maintain records to demonstrate evidence of quality and

accountability. These records shall include results of inspections, tests, process controls, certification of processes and personnel, discrepant material and other quality control requirements.

- 8.4.3 Inspecting and testing records shall be in ISO format and as a minimum, indicate the nature of the observations made, the number & types of deficiencies found and action proposed to correct deficiencies. Also, records for monitoring work performance and for inspecting and testing shall indicate action taken for the correction of deficiencies.
- 8.4.4 The Contractor shall submit to the Engineer a request for a "Notice of No Objection to Supply" for the manufactured items along with all the relevant manufacturer's test certificates and inspection certificates prior to shipping / transporting. However, the material which have been inspected and the testing of which has already been witnessed by the Employer's representative, the "Notice of No Objection to Supply" may be issued directly by the Employer's representative.

8.5 PACKAGING, TRANSPORTATION AND STORAGE OF PLANT AND MATERIAL

8.5.1 Packaging and Shipping

- (1) The packaging and shipping shall be done keeping in mind that the equipment and cables do not get damaged during transit. The Contractor's quality control personnel shall verify the inspection and preparation for shipment.
- (2) Each case, crate or package shall be of robust construction and suitable for the intended purpose. Packaging material that are likely to suffer deterioration in quality as a result of exposure to environmental conditions likely to be met during transit from the factory of origin to the Site shall not be used.
- (3) Each case, crate or package shall be legibly and indelibly marked in large letters with the address, Contract number, 'right way up', opening points and other markings like "fragile", "keep dry", "handle with care" etc. along with visual display of internationally accepted symbols as necessary to permit material to be readily identified and handled during transit and when received at Site.
- (4) Each case, crate or package shall contain a comprehensive packing list showing the number, mark, size, weight and contents together with any relevant drawings. A second copy of the packing list shall be enclosed in a watertight enclosure on the outside of each case, crate or package. Distribution of additional copies of each packing list shall be in accordance with the requirements of the Engineer.
- (5) Care shall be taken to prevent movement of equipment within containers by the provision of bracing, straps and securing bolts as necessary.
- (6) Bags of loose items shall be packed in cases and shall be clearly identified by well-secured metal labels on which the quantity and name of the part and its index or catalogue number have been stamped.
- (7) Spare parts shall be suitably packed for storage over an indefinite period without deterioration and shall be clearly identified showing full name and part number without any need to unwrap packaging. Electrical and other delicate items or equipment shall be cocooned.
- (8) Cable ends, cable entry points into equipment and other similar terminations and openings shall be sealed or blanked off to prevent the ingress of dirt, vermin or moisture.
- (9) Tube ends and other similar openings shall be thoroughly cleaned and then blanked-off to prevent ingress of dirt or moisture.

- (10) Particular care shall be taken to prevent damage to or corrosion of shafts and journals, where they rest on timber or other supports that may contain moisture.
- (11) At such points wrappings impregnated with anti-rusting compositions shall be used, of sufficient strength to resist chafing under the pressures and movements likely to occur in transit.
- (12) Care shall be taken to minimize risk of damage to ball and roller bearings and any fragile material in transit.

8.5.2 Cable Drums

- (1) Immediately after the tests at the place of manufacturing, both ends of every length of cables shall be sealed by enclosing them with approved caps, tight fitting and adequately secured to prevent ingress of moisture.
- (2) The ends of the factory lengths of cable shall be marked "A" and "Z", "A" being the end at which the sequence of core numbers is clockwise and "Z" the end at which the sequence is anti-clockwise.
- (3) The end which is left projecting from the drum shall be consistently "A" or "Z", and shall be protected against damage in such a manner that the enclosure cannot be easily removed during handling while in transit.
- (4) Cables shall be supplied on drums in the longest possible lengths and within practical limits.
- (5) The maximum allowable diameter of cable drum shall be 2000 mm. The use of cable drums with diameter in excess of 2000 mm shall be subjected to the review of the Engineer.
- (6) The drums shall also be designed for use in conjunction with any special cable-laying equipment and accessories complete with spindles and cable drum braking gear, which shall be used to install the cables on Site.
- (7) Each drum shall bear a distinguishing number and label "HRIDCL", either printed or neatly chiselled on the outside of a flange.
- (8) Particulars of the cable, i.e. voltage, length, conductor size, number of cores, section and length, gross and net weights, shall be clearly shown on one flange of the drum.
- (9) An arrow showing direction of rolling shall be shown. Both ends of the cables shall have heat shrinkable caps. The caps shall incorporate sealants which melt on heating at temperatures well above outdoor ambient expected in DFCC area.

8.5.3 Handling, Storage and Delivery

- (1) The Contractor shall ensure Comprehensive Test and inspection instructions for handling, shipping, storage, preserving, packaging, packing, marking, and shipping to protect the quality of the equipment and to prevent damage, loss, deterioration, degradation or substitution thereof.
- (2) Handling procedures shall include the use of special crates, boxes, containers, transportation vehicles, equipment and facilities for material handling.
- (3) Unless otherwise consented by the Engineer, the Contractor shall provide adequate and covered storage facilities for storing in a safe and secure manner all the plant & equipment and manufactured items to be supplied and erected as part of the Contract.
- (4) The Contractor shall make its own arrangement of space for storage facility. However, if the spare land is available with the Employer, the same will be handed

over to the Contractor free of cost, for the purpose of establishing temporary construction depot(s) with the condition that whenever the Employer requires this portion of land back, the same shall be handed over by the contractor at a month's notice at no extra cost/compensation to the Contractor.

- (5) Means shall be provided by the Contractor for protection against deterioration or damage to equipment in storage. Where shelf-life of the equipment / material is limited, this shall be clearly stated on the shipment. Secure compound and storage for the high value items shall be integral part of the safe storage. Spares to be supplied shall also be kept safe and secure until handed over to the Employer at the time of Commissioning.
- (6) The Contractor shall include the delivery activities in his Monthly Schedule Updates that he would submit to the Engineer in accordance with provisions of Chapter 3 of this GS.
- (7) The Contractor shall ensure the Site is ready and in good conditions for delivery.
- (8) The Contractor shall remove temporary fittings, if necessary, for delivery of his items to site and shall restore the fittings to the original state and to the satisfaction of the Engineer.
- (9) No dangerous goods shall be delivered to the Site.

8.5.4 General Precautions

- (1) Spare parts shall be suitably packed for storage over an indefinite period without deterioration and shall be clearly identified showing full name and part number without any need to unwrap packaging. Electrical and other delicate items or equipment shall be cocooned.
- (2) Cable ends, cable entry points into equipment and other similar terminations and openings shall be sealed or blanked off to prevent the ingress of dirt, vermin or moisture.
- (3) Tube ends and other similar openings shall be thoroughly cleaned and then blanked-off to prevent ingress of dirt or moisture.

8.6 INSTALLATION

- 8.6.1 The Contractor shall carry out site surveys to ensure sufficient knowledge of the Site before submitting the relevant installation drawings and installation related submissions to the Engineer for review.
- 8.6.2 The Contractor shall provide all necessary and sufficient resources such as tools, test instruments, spares, and equipment, manpower and communication facilities to complete all the installation activities.
- 8.6.3 The Contractor shall ensure that all Installation works are supervised and technical, safety and quality matters adhere to the Design as reviewed by the Engineer.
- 8.6.4 The Contractor shall take every precaution to protect existing equipment and facilities on Site from damage and shall make good any damage caused. Care shall also be taken not to interfere with the operation of existing equipment(s).
- 8.6.5 During installation, care may be taken to ensure that the manufacturer's erection instructions are correctly followed.
- 8.6.6 The installation for major items such as important components and vital equipment shall be undertaken preferably in the presence of the manufacturer's field service

representative.

- 8.6.7 All installation activities shall commence only after the method statement and related submissions have been reviewed without objection by the Engineer.
- 8.6.8 The Contractor shall ensure that his staff are competent and possess all the necessary skills to carry out the installation in a proper and safe manner.
- 8.6.9 The Contractor shall assign competent site supervisors for each work site to be responsible for all site-related matters.
- 8.6.10 The Contractor shall carry out regular site audit on both technical and safety matters and maintain records of the site audits. The Contractor shall make these records available to the Engineer for inspection upon request.
- 8.6.11 All the equipment shall be installed in accordance with OEM's installation checklist. A certificate shall also be required to be issued by the OEM that the installation has been done in accordance with the Installation checklist and Earthing and surge protection arrangements are in accordance with latest RDSO specification. The equipment shall not be commissioned unless such a certificate has been issued by the OEM.

8.7 INSTALLATION METHOD STATEMENT

- 8.7.1 Installation Method Statements which is part of the Construction/Installation Method Statement shall be submitted to the Engineer for review at least 28 days prior to the installation activity commencing on site.
- 8.7.2 The installation method statement shall include the details on the methods and procedures of installation, site arrangement, manpower resources, equipment and tools required. Drawings shall be included to illustrate the proposed installation details.
- 8.7.3 Prior to proceeding with installation, the Contractor shall submit, for the Engineer's consent, six copies of drawings showing all installations including dimensions, supports, hardware, installation methods and documents confirming the availability and location of special installation tools and equipment and all other pertinent data.
- 8.7.4 The Contractor shall make certain that the installation of all supports, gaskets, hardware, etc., are accomplished so as to assure safe, accurate and trouble-free installation. The installation for major items such as important components and vital equipment such as Traction and Auto transformers shall be undertaken preferably in the presence of the manufacturer's field service representative.
- 8.7.5 Upon noticing or being advised of any inconsistencies between the installation drawings and documentation and the installed equipment, the Contractor shall notify his acknowledgement to the Engineer and correct such errors within two weeks.
- 8.7.6 Equipment that is improperly installed shall be removed, checked / tested and reinstalled. Any damage caused due to improper installation and removal shall be rectified before reinstallation at no extra cost to the Employer.

8.8 MATERIALS AND WORKMANSHIP

- 8.8.1 Materials utilized in the Works shall be free from defects, shall be new, recently manufactured and of a classification and grade in full conformity with the Contract.
- 8.8.2 Products and equipment shall be approved only when the Engineer has been satisfied as to their strength, reliability and suitability as per application duty requirement. To assist the Engineer in this respect, the Contractor shall furnish on request, performance data, references to completed works and any other relevant information together with samples of materials for approval. Materials and any other articles adopted without the approval of

the Engineer shall be rejected.

- 8.8.3 The Works shall be constructed in accordance with the Good Industry Practice and shall comply with all local regulations and codes of practice which apply to such Works.

8.9 INSTALLATION MATERIAL

- 8.9.1 The Material used for Installation as Permanent Works shall be new, rust free and complies with the relevant specifications.

- 8.9.2 Certificates of tests by manufacturers which are to be submitted to the Engineer shall be current and shall relate to the batch of material delivered to the Site.

- 8.9.3 True copies of certificates, duly certified by the manufacturer and the Contractor may be submitted if the original certificates could not be obtained from the manufacturer.

- 8.9.4 Parts of material which are to be assembled on the Site shall be marked to identify the different parts.

- 8.9.5 Material which are specified by means of trade or proprietary names may be substituted by material from a different manufacturer which has received the consent of the Engineer provided that the material are of the same or better quality and comply with the specified requirements.

- 8.9.6 Samples of material submitted to the Engineer for information or consent shall be kept on the Site and shall not be returned to the Contractor or used in the Permanent Works unless permitted by the Engineer.

- 8.9.7 The samples shall be used as a means of comparison which the Engineer shall use to determine the quality of the material subsequently delivered. Material delivered to the Site for use in the Permanent Works shall be of the same or better quality as the samples which have received consent.

- 8.9.8 All the surplus serviceable material, if not required by the Employer, and unserviceable material shall be carried away from the Site by the Contractor and disposed off in the manner consented by the Engineer.

8.10 MOCK-UPS

The Contractor shall construct mock-ups, if required, to demonstrate to the satisfaction of Engineer that the designs of the elements of the System will fulfill the requirements of the Contract.

8.11 DISPOSAL OF SURPLUS MATERIAL

The disposal of surplus or waste material, debris of demolished existing structures or buildings and unsuitable material etc. shall be the responsibility of the Contractor and this material shall be treated and disposed of by the Contractor at an approved location(s) at his own cost. The disposal plan and program shall be subject to approval by the Engineer.

8.12 ASSET IDENTIFICATION

- 8.12.1 The Contractor shall submit for review by the Engineer an asset Information database as below but not limited to:

a) Asset Description;

- b) Rating/ size details
- c) Date Manufactured, Batch no.
- d) Date of Installation
- e) Testing log with date and results.
- f) Failure History

8.12.2 All equipment and software shall have a unique identification number that can be identified electronically and manually.

8.13 8.13 TESTING & COMMISSIONING

8.13.1 The Contractor shall provide and perform all forms of Inspection and testing procedures applicable to the Works relating to plant & equipment and manufactured items and various components and the interfacing of the Works relating to plant & equipment and manufactured items with the other contractor(s) and shall conduct all necessary factory, site & acceptance tests.

8.13.2 The commissioning activity shall include a period of the Integrated System testing followed by a period of Trial Run.

8.13.3 Within 180 days from the date of Commencement of the Work, the Contractor shall submit a comprehensive Testing Program defining the personnel, procedure and format of testing.

8.13.4 All testing procedures shall be submitted at least 56 days prior to conducting any Test. The testing procedures shall show unambiguously the extent of testing covered by each submission, the method of testing, the acceptance criteria, the relevant drawing (or modification) status and the location.

8.13.5 The testing procedures shall be submitted by the Contractor and amended subsequently, if required, by the Contractor during the duration of the contract to reflect changes in design of works, interface systems or the identification of additional testing requirements, if needed.

8.13.6 The contractor shall facilitate the Employer's Personnel/ the Engineer to inspect the works and monitor all tests and have access to all testing records.

8.13.7 Sufficient time shall be allowed within the Testing Programs for necessary alterations to equipment, sub-systems and designs to be undertaken, together with re-testing prior to final commissioning.

8.13.8 The Contractor shall keep in mind that at some point of time, the electric Traction System shall be energized and the additional precautions for the safety and co-ordination of the activities prior to and after 'power-on' shall be anticipated in his co-ordination with other contractors and installation, testing and commissioning Programs of all the contractors and all associated with the Traction Power Energisation Program.

8.13.9 The testing/inspection of the material shall be done by the Engineer's/ Employer's Representative *or RDSO or Third Party as nominated by the Employer* and all costs associated with the testing/inspection shall be borne by the Contractor including travel/lodging/boarding charges of the Engineer's and/or Employer's Representative Any testing/inspection charges to be paid to the Test Laboratories *etc.* shall also be borne by the Contractor.

8.13.10 The Contractor shall bear all expenses including hotel/travel/cost of witnessing, if any, incurred due to retesting caused by defects or failure of equipment to meet the requirements of the Contract in the first instance.

- 8.13.11 The Contractor shall provide and perform all types of tests applicable to the Works as stipulated in this GS and the PS.
- 8.13.12 The Contractor shall submit Test Plan(s) for approval by the Engineer and shall demonstrate that the tests are sufficient and adequate to meet the requirements of this Contract. This will include the EMC and EMI tests.
- 8.13.13 The witnessing of any Test by the Employer's personnel / Engineer shall not relieve the Contractor from his obligations, responsibilities and liabilities to complete the Works in accordance with the Contract nor relieve him of any of his obligations, responsibilities and liabilities under the Contract.
- 8.13.14 In the event of any test being performed in the countries other than India, the Contractor shall give at least 56 days' notice to the Engineer for witnessing the test. The Contractor shall not be required to bear the cost of the Employer's Personnel/ the Engineer visit i.e. travel expenses, boarding/lodging etc.
- 8.13.15 If test reports are not acceptable as proposed due to absence of approved Test plan and procedures and/or Reports, failure to fulfill the pass/fail criteria, negligence, lack of preparation or unacceptable material and/or equipment, all costs incurred by the Employer's Personnel, the Engineer or any other personnel nominated by the Employer for repeated inspection and/or witness shall be borne by the Contractor.
- 8.13.16 All testing equipment shall be pre-checked for calibration accuracy by third party as acceptable to the Engineer.
- 8.13.17 The Engineer/ Employer's personnel shall sign all test reports of the test witnessed by him.

8.14 SEQUENCE OF TESTS

The sequence of tests shall comprise as appropriate the following:

- (1) Type Tests, as and when required;
- (2) Routine Test carried out before offering for FAT,
- (3) Factory Acceptance Tests (FAT);
- (4) Installation Tests;
- (5) System / Sub-system Acceptance Tests (SAT);
- (6) Integrated Testing & Commissioning; and
- (7) Trial Run.

8.15 TYPE TEST

- 8.15.1 Type tests shall be carried out on specific items to ensure that they perform their intended functions when subjected to all permutations and combinations of external environment and other factors. If Procured locally, shall be procured from RDSO/CORE approved sources only as per Indian Railway Policy. List of sources are available at RDSO / CORE websites.
- 8.15.2 In addition to the above, Type tests may also be performed for subsystems, components and items of equipment installed in the overall system in substantial numbers.
- 8.15.3 Type Test Reports and Certificates shall explicitly state the mandatory contents of the routine test Program and the individual inspection and measurement procedures that need to be performed on each individual item of identical series production devices or components.

8.16 8.16 FACTORY ACCEPTANCE TEST (FAT)

- 8.16.1 The Contractor shall conduct Factory Acceptance Tests (FAT i.e. Type/Routine/acceptance/special tests) as specified in relevant standards & specifications at the premises of Original Equipment Manufacturer.as needed before dispatch of material.
- 8.16.2 All material, components, sub-assemblies, unit assemblies (including software, cables and wiring) shall be subjected to test and certification. FAT procedure shall be submitted for review by the Engineer Twenty Eight (28) days in advance of carrying out any Test.
- 8.16.3 The FAT shall demonstrate that each equipment /sub-system meets its functional specifications.
- 8.16.4 No equipment or software shall be delivered to the Site until the Contractor has demonstrated, to the satisfaction of the Engineer that the equipment or software conforms to the specifications by carrying out the FAT.
- 8.16.5 Where processor based equipment is to be used, the FAT shall also include verification of software used in this application.

8.17 8.17 PRE-INSTALLATION TESTS

8.17.1 Prerequisites for Installation:

Prior to installation, the Contractor shall ensure that equipment delivered to Site has not been damaged in transit and ensure for their dimensional accuracy.

8.17.2 Inspection:

- a) During the inspection, it shall be verified that
- i. The equipment has been installed as per the procedures & design that have been reviewed without objection by the Engineer and that equipment is correctly located and labeled.
 - ii. Any false feed, temporary wiring and redundant items have been removed and that equipment is correctly protected against interference, damage and deterioration.
- b) The Contractor shall maintain inspection records to demonstrate that each item of equipment has been inspected and found to be satisfactory and attach to this record a detailed list of any discrepancies found and remedial action taken.
- c) As defects are rectified, these shall be recorded on the appropriate inspection record.

8.18 POST-INSTALLATION TESTS

- a. After installation of the equipment, visual inspection and operational tests on un-energized equipment shall be carried out to check the following:
- (i) Cleanliness;
 - (ii) Workmanship;
 - (iii) Confirmation of items conforming to ratings specified;
 - (iv) Water and dust proofing;
 - (v) Leveling, mounting and positioning;
 - (vi) Joints and connections tightness;

- (vii) Cables – dressing, bending radii, jointing and finish at terminals;
 - (viii) Clearances and dimensions in conformity with drawings;
 - (ix) Earthing and bonding;
 - (x) Functioning of circuit breakers, isolating switches and their interlocks;
 - (xi) Protection devices;
 - (xii) Phase sequence verification;
 - (xiii) Conformance to As Built Records.
- b. During and on completion of installation, the Contractor shall undertake testing of all cables, wiring and equipment, instrumentation and protection devices including relays in a progressive sequence and in accordance with the overall-testing Programs.
 - c. The Contractor shall carry out installation tests for each sub-system following Installation but before SAT to demonstrate that the installation has been carried out correctly and equipment is properly housed and fixed.
 - d. These tests shall culminate in SAT to verify the correct operation of all apparatus and where appropriate, correct response to the respective control commands or monitored function.

8.19 SYSTEM ACCEPTANCE TESTS (SAT)

- 8.19.1 The Contractor shall prepare and organize a comprehensive Program of Tests to demonstrate to the Engineer that all systems, sub-systems and apparatus defined under the Contract, when installed, connected and configured as a complete system meet the specified performance requirements in all respects.
- 8.19.2 Prerequisites and requirements for SAT to be satisfied before the commencement of the System Acceptance Tests (SAT) shall be as follows:
 - a. All documentation for the system safety report shall be submitted to the Engineer for review;
 - b. All Installation Tests shall be completed and test records submitted to the Engineer;
 - c. Facilities for the maintenance of the system shall be in place; and
 - d. The SAT Plan shall be submitted to the Engineer for review.

8.20 SAMPLES

- 8.20.1 In addition to any special provisions in the Contract for the sampling and testing of materials, the Contractor shall submit, in response to the request of the Engineer, samples of any materials or fittings which the Contractor proposes to use in the Works.
- 8.20.2 Such samples, if reviewed without objection, shall be retained by the Engineer for the duration of the Contract and no materials or goods of which samples have been submitted shall be used in the Works unless and until such samples shall have been reviewed without objection by the Engineer.
- 8.20.3 The Engineer may reject any materials and goods, which in its opinion are inferior to the samples previously approved and the Contractor shall promptly remove such materials/goods from Site.
- 8.20.4 Samples that have been tested may be utilized in the Works provided that:

- a. The sample complies with the specified requirements;
- b. The sample is not damaged;
- c. The sample is not required to be retained under any other provision of the Contract; and
- d. Consent of the Engineer has been obtained, in writing.

8.20.5 Additional samples shall be provided for testing, if in the opinion of the Engineer:

- a. Material previously tested no longer complies with the specified requirements; or
- b. Material has been handled or stored in such a manner that it may not comply with the specified requirements.

8.21 INTEGRATED TESTING

8.21.1 Integrated Testing on Completion shall include the Work of other contractor(s). The Contractor shall, following satisfactory completion of tests on his works, equipment, sub-systems or system, perform, at the direction of the Engineer, Program of tests to verify and confirm the compatibility and complete performance of his works, equipment, sub-systems or system with the works, equipment, sub-systems or system provided by others.

8.21.2 The Contractor shall submit to the Engineer the requirements and procedures in respect of the Contractor's scope of work for Integrated System Tests in conjunction with the other contractors to demonstrate that the complete system provided under the Contract is fully operational and meets the specified performance criteria.

8.21.3 Integrated Testing & Commissioning refers to those tests undertaken in order to demonstrate that the various components of the railway systems operate satisfactorily between one another and meet all specified requirements for design, operability, safety, and integration with other systems.

8.21.4 These tests shall be entirely within the requirements of one or more of the Project Contracts or they shall involve a multiplicity of Contract procedure. The final Integrated Testing and Commissioning shall be carried out after the SCADA system and OCC have become operational.

8.21.5 Those systems that can be tested without depending on the running of trains, such as SCADA and Telecom system etc., will have their integration tests scheduled to commence as early as possible. It is preferable that any interface problem associated with these "train less" system tests be identified and resolved prior to the commencement of test running.

8.21.6 The Integrated Tests by the Contractor and other contractors shall include a period of Trial Run.

8.21.7 The results of the Integrated Testing and Commissioning shall be compiled and evaluated by the Engineer and the Contractor.

8.21.8 If the Works, or a part thereof, or a Section, or a plant & equipment and manufactured item fail to pass Integrated Testing and Commissioning and the Contractor in consequence proposes to make any adjustment or modification to the Works or a part thereof, or a section, or the plant & equipment and manufactured item, the Engineer may, with the approval of the Employer, instruct the Contractor to carry out such adjustment or modification at his own cost to satisfy the requirements of Integrated Testing and Commissioning within such time as the Employer / Engineer may deem to be reasonable.

8.21.9 If the Works, or a part thereof, or a Section, or a plant & equipment and manufactured item fail to pass the Integrated Testing and Commissioning, the Engineer shall require such failed Test(s) to be repeated under the same terms and conditions. If such failure and retesting results due to the fault of the Contractor and cause the Employer to incur additional cost, the same shall be recoverable from the Contractor by the Employer and shall be deducted by the Employer from any money due or to become due, to the Contractor.

8.22 STATUTORY REQUIREMENTS

The Contractor along with others Contractor(s) shall carry out all statutory tests and trials under the supervision of the Engineer, necessary for obtaining sanction of the competent authority, if required, for opening the Railway System.

8.23 TRIAL RUN AND COMMISSIONING

Following satisfactory completion of the Integrated System Test, the Employer will commence an extended period of trial run to prove all technical systems to the satisfaction of the Engineer and Commissioner for Railway Safety or any other Authorized Official and to allow all technical systems to settle and to train staff to become conversant with the working procedures. The Contractor's personnel shall be available throughout the scope of work over the whole of this period. After successful Trail Run and obtaining statutory clearances / approvals from CRS / EIG and / or other relevant authorities, the Works shall be commissioned with the consent of the Engineer.

8.24 TESTING RECORDS

8.24.1 Tests Reports

- (1) The Contractor shall submit manufacturer's type and routine test certificates and reports for each equipment and device. Complete test results are to be submitted in clearly identified and organized booklet, indicating item of equipment, make, model, type, date of tests, and type of tests, descriptions and procedures. Test reports shall also include the Quality Assurance Certification, the standards to which the equipment comply, and the standards to which the equipment was tested.
- (2) The Contractor shall submit to the Engineer for review, not less than three (3) months before testing and commissioning activities commence his proposed format for testing and the commissioning records. The records shall be appropriately sub-divided to make provision for the various parts of the Permanent Works covered by the Contract.
- (3) The format of the records shall cover all tests, provide positive identification by serial number for assemblies and sub-assemblies of the Works and show modifications to Employer's drawings and diagrams or "As Built" data to be certified by the Engineer in the course of installation, testing and commissioning.
- (4) The Contractor shall, during the execution of the Works, prepare such reports and record of design, manufacture, installation and testing, as may be required, in order that a license may be issued or statutory requirements may be met or approval given. Such reports or records shall be adequate to enable each part of the Permanent Works to be commissioned and to meet the requirements of the licensing authority or any standing statutory regulations and shall be reviewed by the Engineer.
- (5) The Contractor shall obtain report of each inspection and/or test. Such report shall show the result of all the inspections and/or tests carried out and shall certify that the work has been inspected and/or tested in accordance with the requirements of

the Contract and that the work complies with the requirements of the Contract.

- (6) The Contractor shall prepare an inspection or test report immediately after the completion of each inspection or test whether or not witnessed by the Employer or the Engineer. If the Employer or the Engineer or Employer's Representative has witnessed the inspection or test, he may countersign the inspection or test report to indicate his review of the information and conclusions (i.e. whether or not the equipment being inspected or tested has passed satisfactorily contained therein). If the Employer or the Engineer has not witnessed the inspection or test (i.e. if a waiver has been granted, or the Employer or the Engineer has not witnessed the inspection or test for some other reason in accordance with the Contract), the Contractor shall forward two copies of the inspection or test report without delay to the Engineer. The Engineer will countersign the report to indicate his review of the information and conclusions (i.e. whether or not the equipment being inspected or tested has passed satisfactorily) and return one copy to the Contractor. Where the results of the inspection or test do not meet the requirements of the Specification, the Employer/ the Engineer may call for a re-inspection or re-test.
- (7) The Contractor shall carry out an analysis of the results and certify that the work has been inspected/tested in accordance with the requirements of the contract and the work complies with the requirements of the Contract.
- (8) Authorized representative of the Contractor, who has been assigned the required authority under the relevant quality plan, shall sign each report of inspection and/or test.
- (9) In addition to any other requirements, the report shall contain but not limited to as below:
 - a. Material or part of the Works tested;
 - b. Location of the batch from which the samples were taken or location of the part of the Works;
 - c. Place of testing;
 - d. Date and time of tests;
 - e. Weather conditions in the case of in-situ tests;
 - f. Technical personnel supervising or carrying out the tests or inspection;
 - g. Size and description of samples and specimens;
 - h. Method of sampling;
 - i. Properties tested or inspected;
 - j. Method of testing or inspection;
 - k. All relevant checklists and work sheets used during the inspection and/or test , including readings and measurements taken during the tests;
 - l. Test results, including any calculations and graphs;
 - m. Specified acceptance criteria; and
 - n. Other details stated in the Contract.

8.24.2 After Commissioning of a part of the Works, the Contractor shall complete each commissioning record in the agreed format and shall forward copies of the record to the Engineer for review.

(End of Chapter 8)

CHAPTER 9 - SITE ESHS PLAN

9.1 GENERAL

Environment, Social, Health and Safety Manual is attached as Section VII-4.. ESHS Manual in Part 2-Employer's Requirements. This ESHS Manual shall be applicable on the Works being carried out under this Contract.

(End of Chapter 9)

CHAPTER 10 - INTERFACE MANAGEMENT PLAN

10.1 GENERAL

- (1) The System Contractor (SYS-1) shall be responsible for interface planning and management of all the systems works: Power supply Installations, OHE, ROCS, and SCADA works within the scope of his Contract with the Civil / Tunnel / Bridge / Track Works Contractors, Signalling & Telecommunications Contractor, OHE Contractor (MSIL(OHE)) and other dedicated Contractor(s) in the adjoining section(s) including IR/DFCCIL and other regulatory agencies.
- (2) The Contractor shall co-ordinate its interface requirements with the Employer and other interfacing contractors i.e. CST and other contractor(s) etc. which the Employer may engage from time to time in such a manner so as to minimize disruption to any party arising from such concurrent work.
- (3) The co-ordination responsibilities of the Contractor shall include, but not be limited to the following:
 - a. Provision of all information reasonably required by the interfacing parties in a timely and professional manner to allow them to proceed with their design or construction activities and specifically to meet their contractual obligations.
 - b. Assurance that the interfacing parties' requirements are provided to all other interfacing parties in time providing them ample opportunity to do their part of requirement for interfacing.
 - c. Receipt from the interfacing parties of such information as is reasonably required to enable the Contractor to meet the design submission schedule as identified in Chapter - 4 "Project Program Requirements" of this GS.
 - d. Where the execution of the work of the interfacing parties depends upon the Site management or information to be given by the Contractor, the Contractor shall provide to such interfacing parties the services or information required to enable them to meet their own program or to enable them to construct their work.
 - e. Co-ordination of track possessions, access and delivery routes, and assurance that all provisions for access and delivery of Plant are coordinated with and reflected in the interfacing parties' delivery route drawings.
 - f. Co-ordination with the interfacing parties in attendance.
 - g. The Contractor shall conduct separate meetings with the interfacing parties as necessary to clarify particular aspects of the interfacing requirements of the Works.
 - h. The party convening the meeting shall prepare minutes recording all matters discussed and agreed at the meeting.
 - i. Assurance, copies of all those correspondence, drawings, meeting minutes, programs, etc. relating to the Contractor's co-ordination with the interfacing parties are issued to all concerned parties and four (4) copies issued to the Engineer no later than seven (7) calendar days from the date of such correspondence and meetings.

- (4) The Contractor shall, in carrying out his co-ordination responsibilities, provide sufficient information for the Engineer to decide on any disagreement between the Contractor and the interfacing parties as to the extent of services or information required to pass between them.
 - a. If such disagreement cannot be resolved by the Contractor despite having taken all reasonable efforts, the decision of the Engineer shall be final and binding on the Contractor(s).
 - b. Where an interfacing contract is yet to be assigned, the Contractor shall proceed with the co-ordination activities with the Engineer until such time as the interfacing contractor is appointed.
 - c. The Contractor shall note that the information exchange is an iterative process requiring exchange and updating of information at the earliest opportunity and shall be carried out on a regular and progressive basis so that the process is completed for each design stage by the respective dates.
 - d. The Contractor shall co-ordinate with the Engineer on all matters relating to works that may affect the IR operation on the existing railway. Such works shall be carried out in accordance with IR Rules and Regulations.

10.2 INTERFACE MANAGEMENT PLAN (IMP)

- (1) Contractor shall be responsible for identifying all internal and external interfaces and shall develop and maintain a full interface management system which shall cover the functional and technical aspects of all the internal and external interfaces of the Contractor.
- (2) The Contractor shall prepare and submit an IMP which shall identify the interface manager, the structure and responsibilities of the interface management team and the procedures that will be implemented to identify and close out all interfaces.
- (3) The Interface Management Plan shall:
 - a. Identify the sub-systems as well as the works and facilities with interfacing requirements;
 - b. Define the authority and responsibility of the Contractor's and all other contractors' (and any relevant sub-contractors') staff involved in interface management and development;
 - c. Identify the information to be exchanged, precise division of responsibility between the Contractor and the other contractor(s) and integrated tests to be performed at each phase of the Contractor's and other contractors' works;
 - d. Address the works program of the Contract to meet the key dates of each contractor and highlight any program risks requiring the Employer's attention keeping in view timeline of systems contractor;
 - e. Address the interface issues during Design as well Construction.
- (4) The Interface Management Plan shall include procedures for identifying and resolving interfaces within the Contractor's scope of work between the Contractor and the Employer and between the Contractor and other contractor(s).
- (5) The timescale for resolving interfaces shall be set down in Co-ordinated Installation Plans (CIP) and with the other contractors.

- (6) All interfaces shall be documented through the use of interface co-ordination documents to ensure that each interface is identified, the responsibilities to provide information are defined, the criteria for resolution are agreed and the progress to resolution can be tracked at all times.

10.2.1 Design Interface

- (1) The Contractor shall commence the design interface with the interfacing contractor as soon as he has been notified by the Engineer that the contract has been awarded to the Interfacing contractor.
- (2) In the case of utility agencies and other statutory boards, interfacing shall commence as soon as it is practicable.
- (3) The Contractor shall, immediately upon award of Contract, gather all necessary information and develop his design to a level where meaningful interaction can take place.
- (4) The Contractor shall submit together, with each of his Design submissions a joint statement from the Contractor and the relevant interfacing party confirming that design co-ordination has been completed and that they have jointly reviewed the appropriate document to ensure that a consistent design is being presented.
- (5) The design interface is an iterative process requiring regular exchange and update of interfacing information and the Contractor shall ensure that the information it requires from the interfacing parties is made known at the outset of each design interface so that the information can be provided in time for the Contractor and the interfacing parties to complete their design to meet their various design submission stages.

10.2.2 Construction & Installation Interface

- (1) Construction & Installation interfacing will be necessary throughout the duration of the Works commencing from the time the Contractor mobilizes on the Site to the completion of the Works. Construction interfacing will overlap the design interface and involve the definition of interfacing parties' requirements that are to be incorporated at the initial stages of the Contractor's installation up to provision of attendance during the testing and commissioning stage.
- (2) The Contractor shall ensure that there is no interference with the Works of the interfacing parties and shall maintain close co-ordination with them to ensure that his work progresses in a smooth and orderly manner.
- (3) The Contractor shall carry out and complete the Works or part thereof, in such order as may be agreed by the Engineer or in such revised order as may be instructed by the Engineer from time to time.
- (4) The Contractor shall liaise with the other contractors in the preparation of Co-ordinated Installation Plan (CIP) which shall include plans prepared collectively and agreed between the Contractor and any other contractor.
 - a. These CIPs shall show, in respect of each other contractor, a design interface, Site access, and installation interfacing.
 - b. The Design Interface phase shall be sufficient for the Contractor and the other contractors to integrate the designs of their respective works.
 - c. The installation interface shall be agreed between the Contractor and the other contractors to ensure that each has sufficient access to the Site for the purpose of carrying out their respective works. The Installation interface

- shall commence after the Design interface of the related activity is concluded.
- d. The CIP shall be fully conforming to the approved Works Program and shall be in logical agreement with all access and Mile stones which shall be clearly identified in the CIP.
 - e. The CIP shall indicate dates for the commencement and completion of each principal activity on Site and delivery and installation of principal items of equipment.
 - f. The CIP shall be updated at regular intervals not exceeding 28 days and agreed with other contractors subject to the approval of the Engineer.
 - g. Should it appear to the Engineer that the actual progress of the Works, the Works Program or the three month rolling program do not conform with the CIP, the Contractor shall be required to revise all such programs and plans such that they do reflect the progress of the Works, are mutually consistent and conform to other provisions of the Contract.
 - h. The CIP shall allow adequate time periods for each interfacing party and the Contractor to install their plant and equipment in the interfacing areas.
 - i. The CIP shall be agreed with and signed by each interfacing party and then submitted to the Engineer not later than three (3) months before the earliest Works Area access date.

10.2.3 Employer's / Engineer's Input

- (1) The Engineer will coordinate the activities of the Contractor with reference to interfacing with other contractors and agencies during all the phases of the Contract.
- (2) The Employer/Engineer, within the scope of the relevant Contract provisions, will support and assist the Contractor for interfacing with Indian Railways Authorities, State and local authorities for timely receipt of the required permits, certificates and approvals related to the design and construction process;
- (3) This support and assistance of the Employer/Engineer shall not absolve the Contractor of any of his obligations under this Contract.

10.3 INTERFACE CO-ORDINATION DOCUMENT (ICD)

- (1) The Contractor shall create, in co-ordination with the other contractors, an Interface Co-ordination Document (ICD) for each interface, which shall be signed by all the parties involved.
- (2) An interface list shall be prepared and maintained by the Contractor and updated on a regular basis to reflect the actual needs of both parties.
- (3) The Contractor shall co-ordinate all interface items on the list and agreed solutions with the other contractors.
- (4) ICD shall be created for each interface describing, in a formal manner, the particulars of the functional and technical requirements to be implemented.
- (5) ICD shall be updated on a regular basis as information becomes available or agreement is reached between two contractors.

10.4 DEDICATED CO-ORDINATION TEAM

- (1) The Contractor shall establish a dedicated co-ordination team led by an Interface Manager cum Co-ordinator reporting to the Contractor's Project Manager.
- (2) The primary function of the team is to provide a vital link between the Contractor's design and manufacturing teams and other contractors. The Contractor shall provide the Engineer with the particulars of the Interface Manager cum co-ordinator.
- (3) The Engineer shall have the right to replace the Interface Manager cum co-ordinator if in his opinion the Interface Manager cum co-ordinator is unable to meet the co-ordination requirements of the Contract.
- (4) The Contractor's attention is drawn to the need for the Interface Manager cum co-ordinator to establish effective dialogues and communication links with the CST, S&T and other interfacing contractors. The Contractor's co-ordination team for interfacing shall comprise a mix of personnel with experience in both design and manufacture of equipment comprising the Works, necessary for effective co-ordination.
- (5) The Interface Manager cum co-ordinator shall assess the progress of co-ordination with CST, S&T and other contractors by establishing lines of communications and promoting regular exchange and updating of information so as to maintain the Contractor's program.
- (6) The complexity of the project and the importance of ensuring that work is executed within the stipulated time require detailed programming and monitoring of progress so that early program adjustments can be made in order to minimize the effects of potential delays.

10.5 CO-ORDINATION WITH OTHER CONTRACTORS AND INDIAN RAILWAYS

- (1) The Contractor shall undertake design co-ordination with other contractor(s) and Indian Railways.
- (2) The Contractor may commence design interfacing with other contractors and Indian Railways prior to the given period once information has been developed to a level where meaningful interaction can take place.
- (3) Design co-ordination shall include, but not be limited to, the following:
 - a. Definition and agreement with other contractors of interface areas and contract limits;
 - b. Definition and design approach by the Contractor with the other contractors and/or Indian Railways regarding environmental control requirements, system functionality requirements and control interfaces;
 - c. Agreement of combined service drawings and structural opening drawings.
- (4) The Contractor shall liaise with the Engineer in developing a uniform identity code system which shall be used to uniquely identify each item of equipment and software component provided under this Contract and provided by the other contractors and/or Indian Railway.
- (5) Such identity codes shall be used for labelling each item of equipment and shall also be used in design reports, drawings and operations and maintenance

manuals. Such codes shall comprise mnemonics for location names and equipment types as well as alpha-numeric for unique numbering.

- (6) The Contractor shall undertake Site activity co-ordination with the other contractors and/or Indian Railways within the periods stated for access and installation interfacing and co-ordination in the agreed CIP.
- (7) The Contractor shall undertake installation and testing in accordance with the milestones set in the Contract and the dates in the CIP and as agreed with the other contractors and/or Indian Railways.
- (8) The Contractor shall undertake a lead role in the co-ordination of the activities associated with integrated systems testing including the co-ordination of other contractors and/or Indian Railways to test and monitor their systems to prove the design and integrity of the systems as a whole.
- (9) It shall be the responsibility of the Contractor to secure from the other contractor(s) and/or Indian Railways, in a timely and correct manner as per the agreed CIP, whatever interface provision is required for the Contractor to carry out its duties under the Contract.
- (10) Any additional cost arising to the Contractor due to his late and/or improper interfacing with the other contractors and/or Indian Railways, shall be to the Contractor's account. Such improper interfacing shall include, but not be limited to:
 - a. Late provision of interfacing information
 - b. Failure to adhere to agreed interface
 - c. Changing an interface after it has already been agreed and signed off

(End of Chapter 10)

CHAPTER 11 - QUALITY ASSURANCE AND MANAGEMENT

11.1 GENERAL

- 11.1.1 The Contractor shall maintain and implement a quality assurance and management system that shall remain in effect during the execution of the Works. The Contractor's quality assurance and management system shall be tailored specifically to the Contract and the Works in accordance with ISO 9001 – Quality Management System, the latest edition of the International Standard ISO 9001, and the Contractor shall submit his quality management system titled as the Project Quality Assurance Plan for Engineer's review as specified herein.
- 11.1.2 The Project Quality Assurance Plan documentation shall include, but shall not be limited to the following:
- a) Project Quality Assurance Plan (Contractor's Integrated Quality assurance documentation);
 - b) Design Quality Assurance Plan;
 - c) Site Quality Assurance Plan (including Inspection and Test Plan);
 - d) Manufacturing Quality Assurance Plans (including Inspection and Test Plan); and
 - e) On-site Inspection Plan for Resources Procurement;
- 11.1.3 The Contractor shall plan, perform and record all quality control activities to ensure that all Works are performed in accordance with the requirements under the Contract and are detailed in the quality plans which are required herein. Such activities shall include, without limitation, the inspections and/or test expressly or implicitly required by the Contract.
- 11.1.4 Quality audits will be carried out by the Engineer and surveillance audit shall be carried out by Employer to verify the Contractor's implementation and compliance with the quality management system as specified herein.

11.2 SUBMISSION OF QUALITY DOCUMENTATION

- 11.2.1 Quality system documents to be submitted shall embrace all activities of the Contractor and his Sub-Contractors of any tier including his suppliers and any design consultants for the execution of the Works.
- 11.2.2 The Contractor shall prepare and submit the following documents for review by the Engineer:
- a) Contractor's Quality Assurance Philosophy;
 - b) Project Quality Assurance Plan; and
 - c) Design Quality Assurance Plan and any associated work instruction and/or standard forms which the Contractor proposes to be used for the Contract.
- 11.2.3 The Contractor shall submit separate Site Quality Assurance Plan and Manufacturing Quality Assurance Plans for managing, controlling and recording the on-site construction and manufacturing process including off-site process for individual key items of the Works. The Manufacturing Quality Assurance Plan shall be submitted for review by the Engineer for his consent as part of Detailed Design development as described in Chapter

8: "Supply, Installation, Testing & Commissioning".

- 11.2.4 The Contractor shall submit separate On-site Inspection Plan for Resources Procurement for managing, monitoring and recording the on-site receipt of general construction resources including all construction material, labour force and works and services delivered to the construction site. The On-site Inspection Plan for Resources Procurement shall be submitted for consent by the Engineer.
- 11.2.5 The Contractor shall continuously review and update the quality system documents to meet the requirements and development of the Works throughout the duration of the Contract. For any amendment to the quality system documents, the Contractor shall prepare and submit the proposed amendment for consent of the Engineer.
- 11.2.6 The Plan shall clearly define the Contractor's policy, Quality Assurance Organization, Management responsibility, the requirements for Quality Assurance personnel, their qualifications, skills and training, the Contractor's Quality Audit schedule.
- 11.2.7 Records of certifications shall be maintained and monitored by the Quality Assurance personnel. These records shall be made available to the Engineer / Employer for inspection and review as and when required.
- 11.2.8 The Quality Assurance operations shall be subject to the Engineer's verification at any time. The verification will include: surveillance of the operations to determine that practices, methods and procedures of the plan are being properly applied; inspection to measure quality of items to be offered for acceptance; and audits to ensure compliance with the Contract documents.
- 11.2.9 The Contractor's Quality Audit schedule shall be submitted to the Engineer for consent every three months or more frequently as required.
- 11.2.10 The Contractor shall provide all necessary access, assistance and facilities to enable the Engineer / Employer to carry out on-site and off-site Quality Audit / surveillance audit to verify that the Contractor's quality assurance system which has been consented by the Engineer is being implemented fully and properly.

11.3 CONTROLLED COPY OF QUALITY SYSTEM DOCUMENTATION

The Contractor shall promptly supply the Engineer with six (6) controlled copies of his quality system documents duly consented by the Engineer. The Contractor shall maintain such controlled documents throughout the duration of the Contract. In addition, the Engineer may request further copies of the quality system documents and these documents shall reach to the Engineer office within Fourteen (14) days of notification.

11.4 PROJECT QUALITY ASSURANCE PLAN

- 11.4.1 The Project Quality Assurance Plan shall establish the Contractor's management structure which functions efficiently to execute the Works in compliance with the Employer's Requirements under the Contract and shall, without limitation, define as follows:
- (1) A dedicated Quality Assurance Team;
 - (2) Appointment of a Senior Design Engineer and a Quality Assurance Engineer as described hereinafter;
 - (3) A set of organization charts which depict in line with the Contractor's intent of the

quality plans. Each organization chart shall identify the Contractor's managerial staff with reference to any member of the partnership, consortium or joint venture, and the main Sub-Contractors and indicate the reporting structure and the interface relationship between all parties involved;

- (4) Each organization chart which may be subdivided with regard to Works segments, site locations, and phases and stages of the project to ensure complete implementation of the quality management system in every part to the Work;
- (5) The Allocation of responsibilities and authorities given to managerial and technical staff with particular reference to the design and site supervision of the Works; and
- (6) Hierarchy of the quality management system documentation for managing and controlling the whole system.

11.4.2 The Contractor shall submit the Curriculum Vitae (CV) of each member of his Quality Assurance Team and other personnel relevant to his quality management system. Assignment of such personnel shall be subject to prior consent of the Engineer,

11.4.3 The Project Quality Assurance Plan shall without limitation include Quality Assurance procedures for design, construction, manufacturing, supply, installation, testing and commissioning and shall contain control processes for each stage in the Work such as design verification and validation, management of change control, non-conformance procedures, control on sub-standard practices, inspection, testing, auditing and so on.

11.4.4 The Project Quality Assurance Plan shall also include a full list of quality management procedures, method statements, inspection and test plans, standards and protocol and/or standard forms which shall form the frame work of the Project Quality Assurance Plan. It shall define specific procedures to perform the quality management activities and to record the evidence of the activities performed and/or the results achieved. It shall detail the system and the procedure by which the Contractor shall ensure that

- (1) The Quality Assurance Plan is fully observed at all times and
- (2) Any non-compliant and sub-standard material, practice and / or work are brought back to compliance.

11.4.5 It shall cover the requirements of the International Standard ISO 9001 in compliance with the Contract as precedence requirements and shall, without limitation, include the basic management disciplines as follows:

- (1) Review, approval and updating management of the quality system documents to ensure their continuing suitability and effectiveness;
- (2) Design control management to all Permanent Works and/or Temporary Works including design works carried out by Sub-Contractors and sub-consultants. The procedures shall clearly define the review and verification procedures of the designs submittals and the design packages described under the Contract;
- (3) Drawing management in the Contractor's main office and site office(s), including procedures of production, approval, updating, maintaining, storage and distribution;
- (4) Document management including procedures of registration, updating, indexing, filing, maintenance, storage and distribution and monitoring and recording of the submission and re-submission to the Engineer;
- (5) Monitoring, recording and control of the quality system of his Sub-Contractors with respect to their quality of works with relevant time schedule; and

- (6) Quality control of the Works including Quality audits to be held on the Contractor and Sub-Contractors, suppliers and design consultants of any tiers.

11.5 DESIGN QUALITY ASSURANCE PLAN

The Contractor shall prepare the Design Quality Assurance Plan separately for its design Works. The Design Quality Assurance Plan shall establish the Contractor's policy for the design works in compliance with the Employer's Requirements under the Contract and shall, without limitation, define as follows:

- (1) Organization of the Contractor's Design Team in context with the Contractor's entire organization so as that it functions appropriately in this Design-Build Lump Sum Contract;
- (2) Allocation of responsibilities and authorities to be given to the Design Team, to the individual identified design staff and the Subcontractors for particular design works especially the Internal Authorization Process as detailed herein;
- (3) Hierarchy of relevant documentation (including drawings) of quality management system for managing and controlling design works including design works of Subcontractors of any tier to avoid conflicts in the design submissions;
- (4) A list of general procedures to be applied to manage and control the quality of the design works and
- (5) The Functional procedures which maintains the Design Team in whole Contractor's organization to carry out the design works strictly in compliance with the Employer's Requirements and for the benefit of the Employer.

11.6 DESIGN REVIEW

11.6.1 Contractor's Design Team

- (1) The Contractor shall be responsible for the design of the Works and shall ensure his design is correct / accurate and in compliance with the Employer's Requirements and Specifications contained in the Contract. The Contractor shall ensure that all the completed Works are in line with his design and concurrently in compliance with the Employer's Requirements and safe.
- (2) The Contractor shall establish his dedicated design team referred to as the Design Team in his organization to ensure that his design works are strictly in compliance with the Employer's Requirements and Specifications and for the benefit of the Employer. On the other hand, to clarify the responsibilities and the authorities, the Contractor shall also establish a Construction Team independent of the Design Team; thereby the Contractor shall be responsible for assuring the quality of the Works as required in the relevant Particular Specifications.

11.6.2 Senior Design Engineer

- (1) The Contractor shall appoint a fully qualified and experienced full-time Senior Design Engineer whose credentials has been submitted by the Contractor as part of his Technical proposal and has been accepted by the Engineer. The Senior Design Engineer shall act as a representative of Design Team and shall be wholly responsible for the Contractor's design Works.
- (2) The Senior Design Engineer shall be responsible for establishing, implementing,

maintaining and recording Design Quality Assurance Plan.

- (3) The Senior Design Engineer shall be able to discharge his duties without any hindrance or constraint. Accordingly, the Senior Design Engineer and his team shall strictly adhere to ISO 9001–Quality Assurance System of the Contractors, as consented by the Engineer so as to ensure that his decisions and activities with regard to the Quality Assurance be checked and monitored by the internationally acknowledged system. The Contractor shall identify the personnel to whom the Senior Design Engineer shall be responsible and reports to and seek the consent of the Engineer for the same. The Contractor shall also identify personnel necessary under the supervision of the Senior Design Engineer to furnish the Design Team to fully function as intended in the requirements herein and seek the consent of the Engineer. In addition, the Contractor shall make available any such resources that are necessary to ensure the effective implementation of the quality management system.
- (4) The Contractor shall submit details of the authority and responsibility of the proposed Chief Design Engineer for review and consent by the Engineer, as part of the Project Quality Assurance Plan.

11.7 INTERNAL AUTHORIZATION PROCESS

- 11.7.1 All design submissions including Detailed Design, Construction Design, As-Built Documents shall include a valid "Design Certificate" as per GS Chapter-15, Appendix-3: "Design Certificates" duly signed by Chief Design Engineer in the Contractor's Design Team and Contractor's authorized Representative, thereby demonstrating that:
- (1) Design of the Permanent Works complies with the relevant Particular Specifications
 - (2) In-house checks have been undertaken to conform the completeness, adequacy and validity of the design as per all the quality assurance procedures
 - (3) All the required approvals has been obtained
 - (4) Design has been performed and finalized utilizing the skills of a professionally qualified, competent and experienced designers and engineer(s)
- 11.7.2 The Contractor shall fully verify the respective design outputs as a set of submissions through the Internal Authorization Process by signing and attaching "Design Certificate" as the covering document. Forms, further details and other requirements of the contents of the respective Design Package are detailed in Employer's Requirement, GS, Part 2, Section VII-1,
- 11.7.3 After receiving the "Notice of No Objection" or "Notice of No Objection with Comments" in respect of the Construction Design, all the original paper drawings in respect of Working Drawings shall be endorsed as "Good For Construction" by Senior Design Engineer before issuing it to the Site or submitting to the Engineer for his endorsement as specified in GS, Chapter-3: "Project Planning & Management".
- 11.7.4 In case the Contractor contemplates any change in the design already submitted to the Engineer for approval and / or for the design and drawings for which the Contractor has already received 'Notice Of No Objection', it shall be dealt as per the provisions of Design Review Procedure detailed in the preceding para.

11.8 SITE QUALITY PLAN

11.8.1 On-site Quality Management Provisions

The Contractor shall prepare a Site Quality Plan separately for the construction and installation of Works. The Site Quality Plan shall include the comprehensive on-site quality management in compliance with the Employer's Requirements under the Contract and shall, without limitation, define as follows:

- (1) Organization of the Contractor's staff directly responsible for the day-to-day management of the construction and installation activities to execute the Works on the site;
- (2) Allocation of responsibilities and authorities given to identified personnel or Subcontractors for particular construction and installation of the Works;
- (3) Hierarchy of relevant documentation (including drawings) of quality management system for managing and controlling construction and installation of the Works including construction and installation works of Subcontractors of any tier to avoid conflicts in the execution of the Works; and
- (4) A list of sequences to be applied to manage, control and record the construction and installation of the Works.

11.8.2 On-site inspection and test provisions

- (1) The Contractor shall also prepare onsite inspection and test plans to manage, control and record any test and inspection activities. The Inspection and Test Plans shall be established for particular activities which require inspection and/or test to meet the quality level required in the Employer's Requirements and as included in any form in the Contractor's design and the Works Specifications. It shall cover the requirements of International Standards ISO 9001 and in compliance with the Contract
- (2) The Contractor shall prepare and maintain a full list of the all Inspection and Test Plans needed under the Contract with submission status and review status and shall submit to the Engineer for his consent.
- (3) Each Inspection and Test Plan for the particular activity shall define, without limitation:
 - i. Scope of activities covered by the plan;
 - ii. A sequence of the Work related to the activities in the scope;
 - iii. Personnel responsible for undertaking the inspections and/or tests and the personnel responsible for certifying the inspections and tests;
 - iv. Inspections and/or test methods, their frequency, and/or reference material to the relevant standard of the inspections and/or the tests;
 - v. Compliance criteria of the inspections and/or tests with clear descriptions of the quality hold point and the quality control point;
 - vi. Documents to be used for reporting the results of the inspections and/or tests with sample documents incorporated into the Plan; and
 - vii. Methods of record keeping and document storage as to the locations to be maintained / stored and procedures for those to be acknowledged / filed.

11.9 MANUFACTURING MANAGEMENT AND QUALITY ASSURANCE PLANS

11.9.1 Manufacturing Quality Management Provisions

The Manufacturing Quality Plans shall define the Contractor's management structure and quality management system for the manufacturing process of the key items of the Works and for the items as requested by the Engineer. Separate Manufacturing Quality Assurance Plans shall be prepared for each manufactured item and submit them to the Engineer for consent. Each Manufacturing Quality Assurance Plans for manufacturing process management shall be established in compliance with the Employer's Requirements under the Contract and shall, without limitation, define as follows:

- (1) Scope of activities and items covered by the plan;
- (2) Organization of the Contractor and/or the Subcontractor responsible for the day to day management of the manufacturing process of the items;
- (3) Allocation of responsibility and authority given to identified personnel for the day to day management of the manufacturing process with particular reference to the supervision, inspection and testing of the process and manufactured items;
- (4) Specific methods including handling and management of the manufacturing process and manufactured items, including but not limited to the following:
 - a. Particulars of the material to be used in the manufacturing process;
 - b. Monitoring and management of manufacturing process in compliance with the approved drawings and specifications;
 - c. Identification or referencing procedures for traceability of the manufactured date;
 - d. Identification of the inspection/ test status of the material and the final manufactured item;
 - e. Disposition of nonconforming material and the manufactured item;
 - f. Handling, storage, packaging, preservation and delivery of the manufactured item; and
 - g. Procedure of monitoring and recording of the ordering and delivery of the item.

11.9.2 Manufacturing inspection and test provisions

- (1) The manufacturing inspection and test plans to be prepared by the Contractor shall cover all the requirements of Tests: Type Tests (wherever applicable), Factory Acceptance Tests, site checks and tests, Installation Tests, System Acceptance Tests and tests on completion as required.
- (2) The inspection is to be conducted by the contractor and witnessed by the Engineer and/or the Employer representative. The Employer may, at his own cost, depute its representative or nominate any other independent inspection agency (in addition or as replacement) for supervising, monitoring and inspection of raw material and manufacturing process at the factory. In order to facilitate such an inspection, the detailed production/manufacturing plan shall be provided by the Contractor to the participants of the inspection as well as to the Engineer at least six weeks in

advance of the commencement of the manufacturing process along with the description of mandatory specifications and tests proposed during the manufacturing process and the tests intended to be conducted on the finished product along with codal permitted tolerances.

11.10 ON-SITE INSPECTION PLAN FOR RESOURCES PROCUREMENT

11.10.1 The Contractor shall establish On-site Inspection Plan for Resources Procurement for managing, monitoring and recording the on-site receipt of general construction resources including all construction material, labour forces, and works and services delivered to the Site and the Temporary Facilities e.g. assembly and tests on assemblies prior to installation, their stacking and storage etc. in the Work Areas.

11.10.2 Onsite Inspection Plan for resources procurement to be prepared by the Contractor shall cover all the requirements.

11.11 TESTS

11.11.1 Tests to be carried out for quality assurance purposes shall be as specified in the Particular Specifications and as per the Quality Assurance Plan / Inspections and Test Procedures duly approved by the Engineer.

11.11.2 The Contractor may employ other tests to further ensure the quality of the Works. In such a case, the Contractor shall be responsible for obtaining prior approval from the Engineer by submitting the test plans with regard to the application of the tests as part of the Project Quality Assurance Plan or its sub-plans.

11.11.3 Test Plan and Procedure

The Contractor shall submit all test plans and procedures for review by the Engineer at least 30 days prior to conducting any test together with the exact time and date of such tests. Test procedures shall show the following unambiguously but shall not be limited to:-

- (1) List of resources required to carry out the various testing activities and their capabilities.
- (2) Date on which the Contractor proposes to conduct each of these listed tests;
- (3) nature and purpose of test;
- (4) extent of testing covered by each submission;
- (5) method of testing and tests requirements with the relevant standards;
- (6) relevant drawing and document (or modification) status;
- (7) location of testing;
- (8) test parameters to be measured with the relevant standards;
- (9) constraints to be applied during the test with the relevant standards;
- (10) defined pass/fail criteria with relevant standards;
- (11) format of the raw data for processing by the Contractor; and
- (12) test instrumentation and test circuitry to be used during the test with the relevant standards.

11.12 QUALITY AUDITS

- 11.12.1 The Contractor shall carry out quality audits on the Works at quarterly intervals or at such other intervals as the Engineer may require, ensuring the continuing suitability and effectiveness of the quality management system. Reports of each such audit shall be submitted promptly to the Engineer for review.
- 11.12.2 The Contractor shall submit, for review by the Engineer, details of the authority, qualifications and experience of personnel assigned to quality audit activities before carrying out quality audits.
- 11.12.3 The Engineer may require quality audits on the Contractor and his Subcontractors to be carried out by his representative or the Employer's staff. In such case, the Contractor shall afford to such auditors all necessary facilities and access to the activities and records to permit this function to be performed.
- 11.12.4 Upon receipt of corrective action request (CAR) or similar document issued by the Engineer as a result of quality audits, the Contractor shall promptly investigate the matter and submit the proposed corrective and preventive actions within 14 days to the Engineer for review. The Contractor shall take timely corrective and preventive actions to rectify the matter and to prevent re-occurrence. Evidence to demonstrate effective implementation of corrective and preventive actions shall be submitted by the Contractor to the Engineer for review.

11.13 NOTIFICATION OF NON-CONFORMITIES

- 11.13.1 If, prior to an issue of the Taking-Over Certificate for the Works or the relevant Section, the Contractor proposes to repair any item of the Works which does not conform to the requirements of the Contract, the Contractor shall immediately submit for review by the Engineer of such proposal and supplying full particulars of the nonconformity and, if appropriate, of the proposed means of repair.
- 11.13.2 If the Engineer issues nonconformity report or similar documents to notify the Contractor of any item of the Works which does not conform to the requirements of the Contract, the Contractor shall promptly investigate the matter and within 14 days of notification by the Engineer, submit to the Engineer for review the remedial measures and necessary actions to be taken to rectify the item and to prevent re-occurrence.
- 11.13.3 The Contractor shall maintain and update a nonconformity register to indicate the status of all nonconformities which are identified by the Engineer/ and or the Contractor. The Contractor shall submit the register for review upon request by the Engineer.

11.14 MONTHLY PROGRESS REPORT ON QUALITY MANAGEMENT SYSTEM

- 11.14.1 The Contractor shall continuously monitor the performance of the quality management system and shall include the same in each Monthly Progress Report.
- 11.14.2 The Contractor shall provide and maintain, at all stages of the Works, a quality control register(s) to identify the status of inspections, sampling and testing of the work and all certificates. Such register shall be updated by the Contractor to show all activities in previous months and shall reach the Engineer's office before 7th working day of each month. Each register shall:

- (1) List the certificates received for each batch of goods and material incorporated in the Works and compare this against the certification required by the Contractor and the Contractor's quality plans;
- (2) List the inspection and testing activities undertaken by the Contractor on each element or segment of the Works and compare these activities against the amount of inspection and testing required by the Contract and the Contractor's quality plans;
- (3) Show the results of each report of inspection and/or test and any required analysis of these results and compare these results against the pass/fail criteria;
- (4) Summaries any actions proposed by the Contractor to overcome any nonconformity; and
- (5) The Engineer shall submit the same to the Employer along with his observations / comments before 15th working day of each month.

11.15 QUALITY RECORDS

The Contractor shall ensure that all the quality records as objective evidence of the implementation of the quality management system are properly indexed, filed, maintained, updated and securely stored.

(End of Chapter 11)

CHAPTER 12 - RELIABILITY, AVAILABILITY, MAINTAINABILITY & SAFETY (RAMS)

12.1 GENERAL

12.1.1 The Reliability, Availability, Maintainability, & Safety activities shall be undertaken throughout the whole course of the project as an Integral part of System Assurance in order to demonstrate in a logical, progressive and traceable manner that:

- (1) The objectives and requirements of the project have been satisfied.
- (2) All systems and components of the works are defined appropriately with verifiable performance benchmarks.
- (3) Proper designs, Calculations and Simulation tools have been used.
- (4) The work has been executed by suitably competent people.
- (5) The designs have been verified by the competent authorities.
- (6) Any manufacturing, construction, installation, testing and commissioning works associated with the project have been validated.
- (7) Safety related aspects of the systems have been identified, analyzed and mitigated such that residual risks have been demonstrated to be as low as reasonably practicable for all project stages.
- (8) RAMS requirements of the Systems have been identified, apportioned to various subsystems and elements of the works and the associated designs for these have been demonstrated to be capable of meeting their allocated performance targets.

12.1.2 The activities shall apply to software design as well as hardware and hardware application designs.

12.1.3 The Contractor shall co-ordinate results of analysis with each engineering discipline, particularly as the results affect engineering and hardware development.

12.1.4 The Contractor shall make recommendations for reengineering or modifications necessary to assure compliance with specified requirements including redundancy, utilization of high reliability components, built-in self-diagnostics and "self-healing"; utilization of in-service status displays to enhance fault isolation and test; easy accessibility and quick disconnect connectors; and, the use of mechanical keying to reduce errors during installation and repair.

12.1.5 The Contractor shall document instances where evaluations or analyses indicate an unresolved problem area and formulate appropriate recommendations as well as maintain records, which show that follow-up action has been taken to resolve the problem.

12.1.6 The Contractor shall maintain documentation of System Assurance throughout the engineering and make it available for examination.

12.2 SYSTEM ASSURANCE PLAN / RAMS PLAN

12.2.1 The System Assurance / RAMS Plan shall be maintained as a live document and

updated as necessary throughout the duration of the Project.

- 12.2.2 The System Assurance plan shall define the Contractor's approach on systematic Compliance to System Requirement Specifications, procedures and schedules for conducting the Reliability, Availability, Maintainability and Safety Engineering. Human Factors Engineering is an integral part of System Assurance and shall be considered and reflected within the System Assurance Plan.
- 12.2.3 System Assurance Plan shall describe the organization, resources and procedures that will be established to manage system assurance activities.
- 12.2.4 This System Assurance Plan will describe the RAM and Safety Assurance activities throughout the project lifecycle, comprising:
- (1) Preliminary Design
 - (2) Detailed Design
 - (3) Final Design
 - (4) Manufacturing and Production
 - (5) Testing and Commissioning
 - (6) Operation
- 12.2.5 The Contractor shall liaise with the Employer/Engineer to establish a comprehensive program of work that will encompass all the requirements of this plan in a time scale that enables the construction, installation, test, commissioning, putting to work and warranty monitoring to be undertaken in good time to meet the overall time scales of the project.
- 12.2.6 The Contractor shall submit a compliance matrix in the Assurance Plan with all phases mentioned above and tasks to be performed and the deliverables to be submitted. These requirements shall also be applied to sub-contractors.
- 12.2.7 The System Assurance Plan as a minimum, shall include:
- (1) Organizing the System Assurance Plan to include the System requirement and obligations towards Safety, Reliability, Availability and Maintainability engineering.
 - (2) Describing the procedures to perform the specific RAMS tasks necessary to meet Safety, Reliability, Availability and Maintainability requirements.
 - (3) Describing the system assurance organization which includes RAM and Safety organization.
 - (4) Clearly defining the responsibilities of personnel directly associated with system assurance activities and implementation of the Program.
 - (5) Application of the relevant standards, Indian Railways (IR) standards, norms, regulations, instructions and the Employer's Requirements / Specifications.
 - (6) Demonstration of compliance with RAMS requirements.
- 12.2.8 The System Assurance Plan shall also include, the following:
- (1) Scope and purpose of Compliance Management.
 - (2) Scope and purpose of Verification & Validation.

12.3 COMPLIANCE MANAGEMENT

- 12.3.1 A compliance management process shall be established and maintained for the duration of the Project to:
- (1) Import all RAMS requirements from the Project documents and ensure compliance to Technical Specifications and System Requirements Specifications.
 - (2) Import design requirements and specifications from each stage of design as they are developed and assess the impact of any changes in these.
 - (3) Provide traceability to demonstrate that high level and low level design requirements and specifications have been verified that they satisfy the RAMS requirements.
 - (4) Provide traceability of review comments made and the associated responses and follow up actions.
 - (5) Provide traceability of non-conformances and follow up actions required to address them.
 - (6) Provide traceability of validation of testing and commissioning results against RAMS requirements or design requirements and specifications.
 - (7) Provide summary reports on key status items including, but not limited to requirements not yet satisfied and incomplete or missing verifications or validations.

12.4 VERIFICATION & VALIDATION

- 12.4.1 Verification and validation activities shall be undertaken to show in a logical, progressive and traceable manner that the:
- (1) The designs satisfy the RAMS requirements.
 - (2) The completed works that have been subjected to testing and commissioning indeed demonstrate that they meet the RAMS requirements.
- 12.4.2 Verification & Validation shall be carried out preferably by an engineering team who are independent from those carrying out the design.
- 12.4.3 All the equipment & components/ Products used in the Contract shall be approved only when the Engineer has been satisfied as to their strength, reliability and suitability. To assist the Engineer in this respect, the Contractor shall furnish on request, performance data, references to completed works and any other relevant information together with samples of materials for approval.
- 12.4.4 Verification methods shall include one or more of the following:
- (1) Analysis of design
 - (2) RAM studies
 - (3) Design safety studies
 - (4) Simulations
 - (5) Calculations

- (6) Benchmarking against international best practice where appropriate, and
- (7) Other methods as appropriate.

12.4.5 Records of all verification and validation activities shall be kept and shall be traceable through the Compliance Management Process.

12.5 SYSTEM ASSURANCE / RAMS ORGANIZATION

12.5.1 The System Assurance organization of the contractor shall have dedicated RAM and Safety Managers who shall have implemented the RAMS strategy for the relevant system in at least one Metro/railway project environment.

12.5.2 Alternately, the Contractor can engage the services of a RAMS consultant to manage the entire scope of the RAMS work.

12.5.3 In the event that Employer engages the services of an Independent Assessor, the Contractor shall coordinate with the Independent Assessor and provide all documentation requested.

12.6 RELEVANT STANDARDS

12.6.1 The RAMS Assurance activities shall comply with the requirements of EN 50126: Railway Application – The specification and demonstration of reliability, availability, maintainability and safety (RAMS) or the equivalent IEC 62278 standards.

12.6.2 RAMS assurance activities related specifically to communications, signalling and processing systems shall comply with the requirements of:

- (1) EN 50128: Railway Application – Communications, signalling, and processing systems – Software for Railway control and protection Systems.
- (2) EN 50129: Railway Application – Communications, signalling, and processing systems – Safety related electronic systems for signalling or the equivalent IEC 62279 and IEC 62280 standards.

12.6.3 Apart from the above mentioned mandatory standards, it is recommended to follow the below mentioned standards of the latest edition.

- (1) IEC 61025: Fault Tree Analysis
- (2) IEC 61078: Analysis techniques for dependability: Reliability block diagram and Boolean methods
- (3) IEC 60812: Analysis techniques for system reliability – Procedure for failure modes and effects analysis (FMEA)
- (4) MIL-STD-1629A: Procedure for performing a Failure Mode Effect and Criticality Analysis (FMECA)
- (5) MIL STD 471-A: Maintainability Verification / Demonstration / Evaluation
- (6) IEC 60300-3-5: Dependability management - Part 3-5: Application guide – Reliability test conditions and statistical test principles.
- (7) IEC 60300-1: Dependability management — Part 1: Dependability management systems

- (8) IEC 60300-2: Dependability management - Part 2: Guidelines for dependability management.
- (9) BS EN 50562:2018: Railway applications. Fixed installations. Process, protective measures and demonstration of safety for electric traction systems.

12.7 LIST OF DEFINITIONS

12.7.1 In this document, following defined terms shall have the meanings as described here below:

Definitions	Descriptions
apportionment	process whereby the RAMS elements for a system are sub-divided between the various items which comprise the system to provide individual targets
assessment	undertaking of an investigation in order to arrive at a judgment, based on evidence, of the suitability of a product
availability	ability of a product to be in a state to perform a required function under given conditions at a given instant of time or over a given time interval assuming that the required external resources are provided
Compliance	Demonstration that a characteristic or property of a product satisfies the stated requirements.
Corrective Maintenance	maintenance carried out after fault recognition and intended to put a product into a state in which it can perform a required function
down time	time interval during which a product is in a down state
Failure mode	predicted or observed results of a failure cause on a stated item in relation to the operating conditions at the time of the failure
Fault tree analysis	analysis to determine which fault modes of the product, sub-products or external events, or combinations thereof, may result in a stated fault mode of the product, presented in the form of a fault tree
hazard	physical situation with a potential for human injury and/or damage to environment
Hazard log	Document in which all safety management activities, hazards identified, decisions made and solutions adopted are recorded or referenced. Also known as a "Safety Log"
maintainability	probability that a given active maintenance action, for an item under given conditions of use can be carried out within a stated time interval when the maintenance is performed under stated conditions and using stated procedures and resources
preventive maintenance	maintenance carried out at predetermined intervals or according to prescribed criteria and intended to reduce the probability of failure or the degradation of the functioning of an item
reliability	probability that an item can perform a required function under given conditions for a given time interval (t_1 , t_2)

Reliability growth	condition characterized by a progressive improvement of a reliability performance measure of an item with time
repair	that part of a corrective maintenance in which manual actions are performed on the item
restoration	that event when the item regains the ability to perform a required function after a fault
Risk	probable rate of occurrence of a hazard causing harm and the degree of severity of the harm
safety	freedom from unacceptable risk of harm
safety case	documented demonstration that the product complies with the specified safety requirements
safety integrity	likelihood of a system satisfactorily performing the required safety functions under all the stated conditions within a stated period of time
safety integrity level (SIL)	One of a number of defined discrete levels for specifying the safety integrity requirements of the safety functions to be allocated to the safety related systems. Safety Integrity Level with the highest figure has the highest level of safety integrity
Safety-Critical	Failure of the system, sub-system or equipment will directly lead to a situation with the potential to cause harm, injury, damage to property, plant or equipment, damage to the environment, or economic loss.
Tolerable risk	maximum level of risk of a product that is acceptable to the Railway Authority
Validation	confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use have been fulfilled
Verification	Confirmation by examination and provision of objective evidence that the specified requirements have been fulfilled.

12.8 SYSTEM RAM MANAGEMENT

12.8.1 RAM Management Activities

(1) **Design Phase** - The RAM Management activities shall include:

- a) Preparation of RAM Plan
- b) Develop RAM allocations for subsystems, assemblies, and equipment.
- c) Perform Reliability, Maintainability and Availability analyses at the Preliminary Design phase.
- d) Perform detailed Reliability, Maintainability and Availability analyses and Prediction at the Final Design phase.
- e) Perform FMECA
- f) Integrate RAM design and analysis results into test planning, maintenance planning, maintenance manuals, and operating manuals.
- g) Establish FRACAS

(2) **Construction and Installation Phase - The RAM activities shall include:**

- a) Updating of Reliability, Maintainability and Availability analyses and Prediction
 - b) Updating FMECA
 - c) Preparation of Reliability, Maintainability and Availability Demonstration Plans
- (3) **Testing, Trials and Warranty Phase - The RAM activities shall include:**
- a) Perform RAM Demonstration.
 - b) Execute a Failure Reporting and Corrective Action System (FRACAS).
 - c) Provide all necessary reports and documentation for tracking by the V&V process.

12.8.2 RAM Plan

RAM Management activities shall be undertaken in order to demonstrate in a logical, progressive and traceable manner that the works satisfy the requirements of the project pertaining to RAM. The objectives of the System RAM Plan are to:

- (1) Define RAM Program scope, tasks, techniques, deliverables, and milestones.
- (2) Provide a RAM Program schedule, which identifies specific tasks, with start and completion dates, and explains how these tasks are coordinated and integrated with major program milestones during design, manufacturing, and testing stages.
- (3) Provide the organization of personnel responsible for performing the RAM Program.
- (4) State methodology to predict compliance with the RAM requirements.
- (5) Provide demonstration testing plans for verification of compliance with RAM requirements.
- (6) Describe monitoring and control of subcontractors and suppliers.
- (7) Define interfaces to and coordination with other system assurance activities such as system safety, design, procurement, and quality assurance.

12.8.3 RAM Analysis and Prediction

- (1) Contractor shall undertake a RAM Analysis and Prediction of the system. The RAM Analysis will provide an initial and broad assessment of all known service failure and service interruption modes for top-level events such as minor, major, and immobilizing service interruptions.
- (2) The purpose of the RAM Analysis is to ensure that the potential service failure modes, causes, and mitigations are well understood by all parties as the design, integration, fabrication, testing, and acceptance activities move forward.
- (3) Reliability shall be assessed in terms of the MTBF/MTBSAF. The assessment will have a bottom up approach commencing from the LRU level and proceeding up to the sub-system and system level. MTBF/MTBSAF is the predicted elapsed time between inherent failures/service affecting failures of a system during operation.
- (4) The RAM Analysis shall also be used to identify and select service failures for in-depth assessment in the Fault Tree Analysis (FTA).
- (5) The Contractor will provide a first iteration of the Reliability Prediction Report for employer's approval. Reliability Prediction Report will be periodically updated until the task is concluded.

- (6) Reliability Predictions shall be conducted at the appropriate level of detail to ensure adequate reliability and fulfilment of the specifications and RAM requirements. This may entail conducting an analysis at the subsystem, assembly, lowest replaceable unit (LRU), block, element, or component level, and may require combining differing analyses from different levels for a single subsystem.
- (7) Reliability Predictions shall be based on existing performance records, reliability test data, warranty and operating data, and reliability prediction analyses from previous similar projects. For equipment with incomplete or inconclusive operating, failure, and/or reliability demonstration data, the equipment supplier will develop a reliability prediction using other information sources, such as, MIL-HDBK-217F Notice 2, Non electronic Parts Reliability Data (NPRD), Manufacturer test data, or any other well-established industrial reliability prediction databases.
- (8) The reliability predictions shall be subject to confirmation during the Reliability Demonstration Test.

12.8.4 Failure Mode, Effects, and Criticality Analysis (FMECA)

FMECA is a systematic procedure for the analysis of a system to identify the probability of occurrence and severity of the potential failure modes, their respective causes and immediate and final effects on systems performance (performance of the immediate assembly and their entire system) and to provide an input to mitigating measures to reduce risk.

- (1) FMECA shall be performed and updated at different project stages until the task is concluded. The FMECA will be intended to:
 - a) Undertake decomposition of the System, Sub-systems from the highest level till the LRU level.
 - b) Provide the lowest-level analysis of failures and failure effects on the system and its subsystems and equipment.
 - c) Identify weaknesses in system hardware and software design and analyse failure modes and effects, particularly for when these details are not established by historical records of equipment operation.
 - d) Use inductive logic in a "bottom up" system analysis. This approach begins at the lowest level which is the Lowest Replaceable Unit (LRU) of the equipment under analysis and traces consequences up to the system level to determine the end effects on sub-system and system performance.
 - e) Identification of single failure points critical to proper system performance.
 - f) Provide early visibility into potential system interface problems.
 - g) Perform Criticality Analysis (CA) of the list of possible failure modes by ranking them in accordance to their risk which is dependent on the probability of occurrence and severity of the failure. The CA will allow prioritization of mitigation measures.
- (2) The purpose of FMECA shall be to identify:
 - a) Those failures which have unwanted effects on safety
 - b) Those failures which have unwanted effects on system operation
 - c) Those failures which have unwanted effects on overall reliability
 - d) To allow improvements of the systems safety
 - e) To allow improvements of the systems reliability

- f) To allow improvement of the systems maintainability
- g) To allow improvements in the systems availability

12.8.5 Reliability Critical Item List (RCIL)

- (1) The contractor shall perform Reliability Analysis to identify Reliability Critical Items List (RCIL). Reliability critical items are those items that have a significant impact on product reliability, performance, safety, availability or life cycle cost. Identifying and controlling critical items is imperative since these parts are often the parts that drive unreliability.
- (2) A critical item output report will be submitted to ensure that reliability critical components were identified and controlled; reliability predictions and an FMECA were performed. Critical items will be identified via the failure rates noted in the prediction and by the single failure point analysis performed in the FMECA.

12.8.6 Maintainability Analysis and Predictions

- (1) The contractor shall perform analytical maintainability analysis and prediction to assure compliance with the specific maintainability requirements and to ensure system performance.
- (2) Maintainability shall be assessed in terms of MTTR. The MTTR shall include the diagnostic time, active repair / replacement time and adjustment / testing time, including software re-boot, up to the point the system is restored to full functionality.
- (3) The MTTR does not include the time taken for designated personnel to arrive on site (access time) to begin local diagnostic activities or the time taken for the replacement parts to be delivered at site.
- (4) In all availability calculations the following access times shall be assumed:
 - a) 30 minutes for train-borne equipment.
 - b) 1 hour for track side.
 - c) 30 minutes for equipment located in equipment rooms.
 - d) 1 hour for Signalling equipment.
 - e) 2 hours for Telecom equipment.
- (5) In the maintainability analysis, the contractor shall lay special emphasis on features such as Built-in-Test (BIT) and fault isolation, acknowledging the criticality of these features to the effectiveness of system testability and maintainability. Built-in-Testing goals should be established that provide the attainment of highest fault coverage detection and isolation to the Lowest Replaceable Units (LRUs).
- (6) The contractor shall perform Maintainability Analysis to identify Maintainability Critical Items List (MCIL). The maintainability critical items are those items that have a significant impact on product maintainability, performance, availability or life cycle cost. Identifying and controlling critical items is imperative since these parts are often the parts that drive system downtime.

12.9 SYSTEM SAFETY MANAGEMENT

12.9.1 Principle of Safety Management

- (1) System Safety Management activities shall be undertaken to demonstrate in a logical, progressive and traceable manner that the works satisfy the safety requirements of the Project.
- (2) The basic principle of safety management shall be that all reasonably foreseeable hazards are identified and action then taken for each hazard as follows:
 - a) Risks arising from the hazard shall be assessed.
 - b) If the risk is broadly acceptable no further action shall be required, otherwise measures shall be taken to reduce or eliminate the risk.
 - c) Each of these measures shall become a 'safety requirement' and all safety requirements shall be subject to verification and validation processes to show that they have been met by design and later by practical tests.
 - d) The mitigation, verification and validation status of all hazards shall be recorded in the Hazard Log.

12.9.2 System Safety Plan

The System Safety Plan shall be developed in accordance with EN 50126 and shall include but not be limited to the following subjects:

- (1) Safety policy;
- (2) Risk acceptance criteria;
- (3) Risk management and Principles;
- (4) Hazard Analysis and Hazard Log;
- (5) Design safety studies; and
- (6) Management of safety during integrated testing, trials, and commercial operation.

12.9.3 Safety Policy

The proposed approach and commitment to safety shall be specified in a statement of safety policy endorsed by the submitter's senior management and this statement shall be included in the System Safety Plan.

12.9.4 Risk Acceptance Criteria

- (1) Risk is defined as probable rate of occurrence of a hazard causing harm and the degree of severity of the harm. Risk acceptance shall be based on the principle of "As Low as Reasonably Practicable" (ALARP) based on the guidelines set out in EN 50126.
- (2) The frequency of occurrence of hazardous event is categorized into different rankings:

Category	Description
Frequent	Likely to occur frequently. The hazard will be continually experienced.
Probable	Will occur several times. The hazard can be expected to occur often.

**Part-2, Section VII-1: Employer's Requirements - General Specifications (GS)- 2x25 kV AC
Traction Electrification and associated work**

Occasional	Likely to occur several times. The hazard can be expected to occur several times.
Remote	Like to occur sometime in the system life cycle. The hazard can be reasonably expected to occur.
Improbable	Unlikely to occur but possible. It can be assumed that the hazard may exceptionally occur.
Incredible	Extremely unlikely to occur. It can be assumed that the hazard may not occur.

(3) The hazard severity is categorized into different hazard consequence levels:

Hazard Category	Consequence	Description
4	Catastrophic	Operating conditions such that personnel error, environment, design deficiencies, subsystem or component failure or procedural deficiencies may cause death or system loss.
3	Critical	Operating conditions such that personnel error, environment, design deficiencies, subsystem or component failure or procedural deficiencies may cause severe injury to personnel, severe occupational illness or major system damage.
2	Marginal	Operating conditions such that personnel error, environment, design deficiencies, subsystem or component failure or procedural deficiencies may cause minor injury to personnel, minor occupational illness or minor system damage. Acceptable with adequate control and agreement of the Employer.
1	Negligible	Operating conditions such that personnel error, environment, design deficiencies, subsystem or component failure or procedural deficiencies will not result in injury to personnel, occupational illness or damage to the system.

(4) Risk classification of hazards:

Frequency		Consequence			
		Catastrophic (Category 4)	Critical (Category3)	Marginal (Category2)	Negligible (Category1)
Frequency	Frequent	I	I	I	II
	Probable	I	I	II	III
	Occasional	I	II	III	III
	Remote	II	III	III	IV
	Improbable	III	III	IV	IV
	Incredible	IV	IV	IV	IV

(5) The Risk Classes are defined as follows:

Risk Class		Interpretation
Class I	Intolerable	Intolerable risk. Shall be eliminated
Class II	Undesirable	Undesirable risk, and tolerable only if risk reduction is impracticable or if the costs are grossly disproportionate to the improvement gained. Shall only be accepted when risk reduction is impracticable and with the agreement of the Railway Authority or the Safety Regulatory Authority, as appropriate
Class III	Tolerable	Tolerable risk if the cost of risk reduction would exceed the improvement gained. Acceptable with adequate control and with the agreement of the Railway Authority.
Class IV	Negligible	Negligible Risk. Acceptable with/without the agreement of the Railway Authority

- (6) Risk acceptance shall be based on the principles of "As Low as Reasonably Practicable" (ALARP) and as follows:
- a) Category 4 hazards: Shall be eliminated.
 - b) Category 3 only be accepted when the risk reduction is impractical and with the agreement of the Employer.
 - c) Category 2 hazards shall only be permitted if a desired benefit is demonstrated as generally acceptable within accepted levels for the international railway industry and in agreement with the Employer.
 - d) Category 1 hazards shall only be permitted if assured that the risk will remain at that level and any residual risk shall be mitigated by Operating Rules and Procedures.

12.9.5 Hazard Analysis

- (1) Hazard analysis shall be carried out to:
- a) Identify and record all reasonably foreseeable hazards associated with all phases of the Works;
 - b) Assess the risk that each hazard represents to this operation; and
 - c) Re-assess the risk after application of the proposed mitigation.
- (2) Where it is not reasonably practical (based on good practice or application of the ALARP principle) to eliminate hazards at the design stage, risk assessments shall be carried out to ensure that the risks associated with residual hazards are in order of precedence:
- a) Minimized through mitigation measures at the design stage;
 - b) Mitigated through special construction, installation and testing and commissioning processes; and
 - c) Mitigated through operations and maintenance procedures.

- (3) Additional mitigation measures shall be proposed as required until such time as the residual risk is assessed to be 'as low as reasonably practicable'.
- (4) The results of the hazard analysis shall be recorded in a Hazard Log in a form that can be used to track progress in the implementation of mitigating actions and provide an easily accessible reference for the future Operator of all actions taken with respect to any hazard.

12.9.6 Primary hazards for Preliminary Hazard Analysis (PHA)

- (1) The PHA shall take into account, but not be limited to, the following primary hazards:
 - a) Fire including:
 - i. smoke asphyxiation;
 - ii. hot works; and
 - iii. explosion;
 - b) Impact including:
 - i. collision;
 - ii. derailment;
 - iii. falling objects;
 - iv. flying objects;
 - v. sharp objects;
 - vi. slipping, tripping and falling;
 - c) Electrocution;
 - d) Other hazards including:
 - i. environmental;
 - ii. flooding;
 - iii. noxious fumes;
 - iv. suffocation;
 - v. entrapment; and
 - vi. burns.
- (2) The PHA shall take into account the various types of operating mode (i.e. normal, degraded and emergency) and the operating scenarios during which all types of hazards might exist including, but not limited to:
 - a) freight service;
 - b) evacuation; and
 - c) maintenance.
- (3) The PHA shall take into account the how each type of hazard might arise including, but not limited to:
 - a) inappropriate design or specification;
 - b) equipment failure;
 - c) installation error;
 - d) improper action (accidental or deliberate);

- e) inaction (unintentional or intentional); and
 - f) external influence.
- (4) The PHA will be followed with the following detailed hazard analysis:-
- a) Sub System Hazard Analysis (SSHA)
 - b) Interface Hazard Analysis (IHA)
 - c) Operating and Support Hazard Analysis (O&SHA)
- (5) The hazard analysis will be supported by following assessment methods:
- a) Failure Mode, Effects and Criticality Analysis (FMECA)
 - b) Fault Tree Analysis (FTA) of top level hazard scenarios.

12.9.7 Design Safety Studies and Report

- (1) The hazard analysis process shall identify the need for Design Safety Studies and the Hazard Log shall record the results of each of these Design Safety Studies.
- (2) Design Safety Studies shall be undertaken for system and subsystem elements that are considered to be safety critical and that require hazard analysis to a greater level of detail than that applied at an overall system wide level.
- (3) Design Safety Studies shall specifically refer to hazards arising from:
- a) normal operations including maintenance;
 - b) degraded modes of operation;
 - c) emergency situations; and
 - d) the effectiveness of mitigation proposed for natural catastrophes.
- (4) The Design Safety Studies shall take account of:
- a) methods of operation;
 - b) RAM considerations;
 - c) anticipated likely maintenance regimes and their sustainability in Commercial Operation;
 - d) anticipated competence levels of personnel in Commercial Operation;
 - e) software security (disabling of unauthorized access to operating systems, protection against intrusive attacks, loss of password integrity, etc.); and
 - f) other human factors including but not limited to those identified in ergonomic studies.
- (5) Design/Systems Safety Studies and the Report shall demonstrate, as a minimum, the following requirements:-
- a) That the overall risk criteria for the Works have been addressed satisfactorily at the Detailed Design stage and that the Detailed Design proposals are mutually compatible with such risk criteria.
 - b) That all Safety Critical systems have been identified at the Detailed Design stage and the apportionment of risk factors between the major systems and sub-systems support the overall safety criteria approved in the "System Safety Plan".
 - c) That the results of the Design Safety Studies have been incorporated into the design, and shall be carried forward into the Final Design, manufacturing and

installation processes.

- d) That where management by operating and/or maintenance procedure or other management control measures have been identified during the “Design Safety Studies”, auditable methods by which such measures shall be introduced into operating/maintenance provisions have been established.
 - e) That robust processes have been implemented to validate the Safety Critical aspects of software design.
 - f) That processes for assessing the potential safety impact of design changes exist.
- (6) A Design Safety Studies and Report shall be submitted at the completion of the design stage to confirm that all safety related aspects of design have been properly addressed and comprehensively verified.

12.10 SOFTWARE QUALITY ASSURANCE PROGRAM (SQAP)

12.10.1 Each software suppliers for Contractors and System Suppliers shall assure software dependability by establishing and implementing a Software Quality Assurance Program (SQAP). The SQAP will:

- (1) Identify, monitor and control all technical and managerial activities necessary to ensure that the software achieves the required quality.
- (2) Ensure that an audit trail is established which enables verification and validation that the SQAP activities were effectively completed.

12.10.2 Each software supplier shall provide evidence that the SQAP activities were carried out, by submitting the documents in given in the Table below.

Documentation	EN Standard
Software Project Management Plan	EN 50128 section 5
Software Quality Assurance Plan	EN 50128 section 6.5
Software Configuration Management Plan	EN 50128 section 6.5, 6.6
Software Verification and Validation Plan	EN 50128 section 6.2, 6.3
Software Requirements Specification	EN 50128 section 7.2
Software Design Description	EN 50128 section 7.3, 7.4
Software Verification and Validation Report	EN 50128 section 6.2, 6.3
Traceability	EN 50128 section 5.3.2.7,D.58

Table 1: Software Quality Assurance Plan Requirements

12.11 RAM DEMONSTRATION

12.11.1 Reliability Demonstration

- (1) Contractor and System Supplier shall perform a Reliability Demonstration to verify that the system meets the required reliability performance requirements when:
 - a) Scheduled maintenance is performed in accordance with approved Maintenance Plan and Maintenance Manuals, and
 - b) Systems are operated within the environmental limits described in the Design documents.
- (2) The demonstration of the system shall continue for a period of 24 months. If at the end of the 24 month test period the equipment has not met the reliability requirements, the System Supplier will implement design changes or modifications, as needed, to meet the reliability requirements. The test duration will be extended to ensure that the changes made result in achieving the requirements.
- (3) Contractor shall submit a RAM Demonstration Test Plan before the Final Design Review. The plan will address the following to illustrate compliance with the reliability requirements:
 - a) Plan schedule and period
 - b) Identification of necessary facility, resources, support equipment, and staff for the demonstration
 - c) RDT procedures and forms for recording and submitting data
 - d) Success failure criteria for measuring reliability values for individual equipment items and subsystems
 - e) Failure analysis of reported failures to identify the cause and need for corrective action
 - f) Establish a Failure Review Board (FRB) to meet with Employer, as required, to determine the need and depth of failure analyses
 - g) Change control procedures for implementing design changes
 - h) Format and location of test records, test logs, and data records
 - i) Final conclusion and report for the demonstration.
- (4) The employer will approve the RAM Demonstration Plan and procedures before the trial commences.
- (5) The RAM Demonstration Procedures shall include all information necessary to ensure the successful, accurate and safe performance of the demonstration testing. The RAM Demonstration Procedures will include, as required:
 - a) Safety Precautions
 - b) Identification of the reliability performance parameters that are verified by the test
 - c) Scope of test
 - d) Test equipment required, if any.
 - e) Personnel required
 - f) Any special conditions required, including condition of the equipment under test

- g) Reference drawings or documents
 - h) Clear pass/fail criteria
 - i) Data sheets to record test results
 - j) Raw data correlation procedures
- (6) RAM Demonstration Procedures shall address the following:
- a) Each equipment failure reported during the RAM Demonstration will be classified as relevant or non- relevant failures by the Failure Review Board (FRB). The assessment will include all failures, whether occurring in or out of revenue service.
 - b) A proposed procedure for corrective action shall be developed and included. The procedure will include proposed changes and appropriate supporting data. The procedure will identify a specific method for verifying the effectiveness of change(s).
 - c) Preventive maintenance procedures specified for the equipment during the RAM Demonstration phase will be performed by the maintainer in accordance with applicable Contract Terms and Conditions.
 - d) System suppliers shall maintain records which contain all the information necessary to calculate reliability performance for the system and major subsystems, and to verify satisfactory reliability requirements. System suppliers shall provide failure and reliability performance records to employer in hard copy and in an approved electronic format.
- (7) A chargeable failure in the RAM Demonstration is defined as any relevant failure that requires repair or replacement of any subsystem or vehicle component. Chargeable failures also include intermittent failures, unverified failures, and software failures.
- (8) Non chargeable failures in the RAM Demonstration are:
- a) Consumable items, except for those which are not achieving their specified life
 - b) A failure occurrence in equipment of another subsystem, due to the primary failure
 - c) A failure of the operator/maintainer to perform recommended preventive maintenance actions
 - d) Vandalism or physical mistreatment at a human interface
 - e) Failures due to an accident.
- (9) Contractor shall provide Weekly Failure Reports during the RAM Demonstration phase. The Contractor will submit the format and structure of the report to employer for review and approval at least three months before system commissioning begins.
- (10) Contractor shall submit Monthly Demonstration Test Reports to employer documenting the current and cumulative failure totals for the system equipment, comparing the totals to the reliability requirements.
- (11) All reports shall clearly identify the system being tested, the date(s) of test, any conditions that may have affected results, and pass/fail status. The test record sheet shall be signed by the personnel performing and witnessing the test. All measured data shall be recorded in numeric form on the reports (not just checked off as acceptable). For the RDT, this means that the applicable support data for the RDT must be included with the RDT Report.

12.11.2 Availability Demonstration

- (1) The Contractor shall demonstrate the specified Availability during Service Trials and during the DLP. The Availability Demonstration Testing (ADT) shall be conducted on all Systems, subsystems and their interfaces.
- (2) In the event that the availability target is not achieved, the determination of availability achievement in the preceding six month period shall be continued at monthly intervals until the target is achieved.
- (3) In the event that the availability target is not achieved, the Contractor shall, at his own expense, take whatever action is deemed necessary to meet the availability requirement.
- (4) The contractor will submit the Availability Demonstration Test Report on completion of the demonstration testing.

12.11.3 Maintainability Demonstration

- (1) Contractor and equipment Supplier shall conduct a Maintainability Demonstration (MD) to establish the accuracy of task time estimates for the preventive and corrective maintenance tasks described in the applicable Maintenance Plan, Maintenance Procedures, and/or Maintenance Manuals. Contractor and equipment Supplier will perform the MD concurrent with the Engineer training program. Contractor and equipment Supplier will demonstrate selected servicing, preventive maintenance, troubleshooting, change out of components, corrective maintenance, and use of special tools where special emphasis, instruction, or proficiency is needed. The Engineer will notify equipment Suppliers which preventive and corrective maintenance tasks have been selected for the MD.
- (2) Maintainability Demonstration Test Plan shall be provided before the Final Design Review.
- (3) In the event that any maintainability target is not achieved, the Contractor shall at his own expense take whatever action is deemed necessary to meet the maintainability targets.
- (4) The contractor shall submit a Maintainability Demonstration Test Report on completion of the demonstration testing.

12.12 FAILURE REPORTING AND CORRECTIVE ACTION SYSTEM (FRACAS)

12.12.1 Purpose of FRACAS

Contractor shall provide a Failure Reporting and Corrective Action System (FRACAS) that supports requirements of the RAM Demonstration and Warranty Program. The contractor shall submit the FRACAS for employer's approval before the Final Design Review. Contractor will use a Failure Reporting, Analysis and Corrective Action System (FRACAS) to track and report on system failures. The FRACAS will consist of a set of data management tools for capturing and reporting on equipment incident data, and a set of procedures which use the data management tools. The FRACAS procedures:

- (1) Implement key project functions of reliability demonstration and warranty administration

- (2) Assess compliance of delivered equipment with requirements
- (3) Provide field and operating information to equipment and project design and analysis tasks
- (4) Assess the effectiveness of modifications to equipment in the field.

12.12.2 Where system failures indicate the possibility of a non-compliant design, the FRACAS process will consist of the following activities:

- (1) Communication of failure information from the operating authority to System Suppliers
- (2) Assessment of the failure conditions, impacts, and possible causes by the System Supplier Quality Assurance and Engineering departments, and by equipment suppliers
- (3) Where appropriate, failure analysis by the equipment supplier
- (4) Corrective action by the equipment supplier
- (5) Once corrective action has been completed through field or factory action, verification by the System Supplier that the implemented solution is adequate and acceptable.

12.12.3 FRACAS Guidelines.

- (1) A comprehensive FRACAS closed loop diagram is depicted as under :

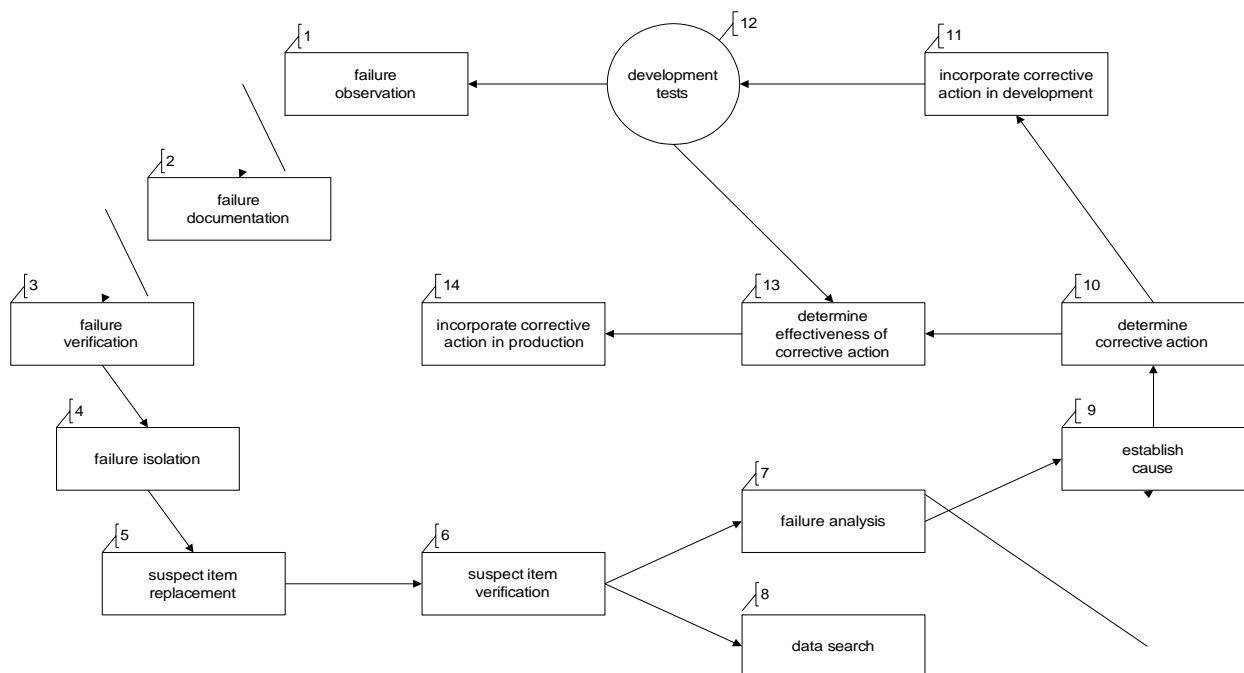


Figure 1: Generic closed-loop FRACAS

- (2) Key steps in FRACAS are as follows:
 - a) Observation of failure
 - b) Complete documentation of failure including all significant conditions which existed at the time of the failure

- c) Failure verification, i.e. confirmation of the validity of the initial failure observation
- d) Failure isolation, localization to the lowest replaceable defective item within the product
- e) Replacement of the suspect defective item
- f) Confirmation that the suspect item is defective
- g) Failure analysis of the defective item
- h) Data search to uncover other similar failure occurrences and to determine the previous history of the defective item and similar related items
- i) Establishment of the root cause of the failure
- j) Determination, by the design team, of the necessary corrective action, especially any applicable redesign
- k) Incorporation of the recommended corrective action into development equipment
- l) Establishment of the effectiveness of the proposed corrective action
- m) Incorporation of effective corrective action into the equipment
- n) The failure documentation should be augmented with the verification of failure (step c above), and verification that the suspect part did indeed fail (step f).

12.13 FAILURE REPORTING FORMATS

12.13.1 Failure Report Forms: All failures shall be recorded on a failure report form which shall contain as a minimum the following information:

- (1) Identification of the equipment, including nomenclature, serial number, manufacturer's part number and location;
- (2) Location of failure;
- (3) Individual who observed failure;
- (4) Operating time of each system including each shut-down and its cause;
- (5) Date and time of each incident;
- (6) Failure symptom/indication, mode, cause and effect;
- (7) Classification of the incident (relevant independent failure or dependent failure);
- (8) Corrective maintenance or operational procedures required to restore the System to operation;
- (9) Time to restore System to operation and active repair time; and
- (10) Circumstances of interest such as Environmental conditions and supply voltages.

12.14 FAILURE DATABASE

12.14.1 The key to a successful FRACAS is its database. This is particularly important in establishing the significance of a failure. For example, the failure of a capacitor in a reliability growth test becomes more significant if the database shows similar failures during incoming inspection of the part and in any environmental tests performed. For this reason all available sources of data should feed the FRACAS.

12.14.2 The Contractor shall maintain the failure database throughout the execution of the Works. The FRACAS system along with the database shall be handed over to the Employer at the expiry of the Defects Notification Period.

12.15 FAILURE REVIEW BOARD

12.15.1 Failure review board (FRB) shall be established consisting of the Employer's Engineer and the Contractor. The FRB shall review failures and assign responsibility.

12.16 ON-SITE TESTING AND INTEGRATED SYSTEM TESTING

12.16.1 General Requirements

The On-site Testing and Integrated System Testing shall demonstrate as a minimum the following requirements:

- (1) That the safety management organization to control the on-site Testing and Integrated System Testing is in place.
- (2) The testing procedures shall ensure that all the critical failure modes as identified during the FMECA / FMEA activity are addressed through proper test cases inclusion. A traceability matrix shall be developed such that these critical failure modes are traced back to the corresponding test cases. All failure modes shall be considered as critical failure modes unless the Contractor demonstrates by a sensitive analysis or other means that the impact of a failure mode on reliability and maintainability will be insignificant.
- (3) That the scope of activities to be carried out during the on-site Testing and Integrated System Testing period covers all Safety Critical functions and Safety requirements including those in the Hazard Log.
- (4) That the segregation of on-site Testing and Integrated System Testing activities from residual construction and installation activities shall be implemented.
- (5) That the procedures required to conduct on-site Testing and Integrated System Testing activities safely, including where necessary, the protection measures for any part of the Railway which may be in operation shall be implemented.
- (6) That the processes which are to be implemented to validate the Safety Critical aspects of software installation and testing shall be implemented.
- (7) That the processes required to assess the safety implications of the results of tests and inspections carried out during the periods of on-site Testing and Integrated System Testing activities shall be implemented.
- (8) That the processes required controlling and validating the safety implications of modifications carried out during the period of on-site Testing and Integrated System Testing activities shall be implemented.
- (9) That the arrangements which are to be utilized to record, report and investigate accidents and incidents together with the systems necessary to formulate and implement measures to prevent reoccurrence shall be implemented.
- (10) That effective controls shall be implemented in respect of the activities of all other contractors, relevant authorities and third parties.

12.17 ENGINEERING SAFETY VALIDATION PLAN

- 12.17.1 Testing shall validate that all safety related functions have been implemented in accordance with the Detailed Design and the safety requirements identified in the Design Safety Report.
- 12.17.2 A Program of all safety validations to be carried out shall be submitted and this Program shall be updated with actual dates of validation during the on-site testing and integrated system testing phase.
- 12.17.3 Validation of the correct implementation of all safety design criteria shall be demonstrated by submitting details including:
- (1) a cross reference to the Program of safety validations;
 - (2) the purpose of each validation;
 - (3) the method of each validation;
 - (4) the qualifications of staff performing the validation;
 - (5) the names of witnesses to the validation;
 - (6) the acceptance criteria for each validation;
 - (7) the results of each validation;
 - (8) analysis of validation results to show that they confirm requirements have been met; and
 - (9) the recommended procedure for the correction of deficiencies observed during the validation process and the steps required to repeat the validation.

12.18 OPERATIONAL SAFETY CASE

12.18.1 General Requirements

In order to demonstrate that the system shall be managed safely, the Contractor shall produce and maintain an Operational Safety Case, in accordance with the System Assurance requirements detailed in the Contract documents.

12.18.2 The Operational Safety Case shall typically consist of but not be limited to the following:

- (1) Executive Summary;
- (2) Introduction;
- (3) Definition of System;
- (4) Quality Management Report;
- (5) Safety Management Report;
 - a) Introduction;
 - b) Roles and Responsibilities;
 - c) Safety Lifecycle;
 - d) Safety Requirements;
 - e) Safety Standards;

- f) Safety Audit and Assessment;
 - g) Supplier Management;
 - h) Safety Controls;
 - i) Configuration Management; and
 - j) Project Safety Training.
- (6) Technical Safety Report
- a) Introduction;
 - b) Assurance of correct functional operation;
 - c) Effects of faults;
 - d) Operation with External Influences;
 - e) Safety-related application conditions;
 - f) Safety Qualification tests; and
 - g) Other Outstanding Safety Issues.
- (7) Conclusion

12.18.3 As part of the Operational Safety Case development process, the Contractor shall ensure that plans and procedures as typically listed below will be in accordance with the Operational Safety Case requirements:

- (1) System Management Plan;
- (2) System Safety Plan;
- (3) System Operating Safety Procedures;
- (4) System Assurance Plan;
- (5) Emergency Preparedness and Fault Recovery Plan;
- (6) Rules and Procedures;
- (7) Relative Indian Railways Rules and Procedures; and
- (8) Health and Safety Regulations.

12.19 PROOF OF SAFETY

12.19.1 General Requirements

The "Proof of Safety" shall demonstrate that the Works are fit for the purpose of commencing Revenue Service. The "Proof of Safety" shall make traceable reference to system documentation that shall demonstrate as a minimum the following requirements have been met:

- (1) That the Works have been manufactured, installed and tested up to an including Integrated System Testing in a manner to ensure that the Railway can be operated and maintained within the parameters of risk as approved in the "Design/Systems Safety Report" and that there are no outstanding safety issues.

- (2) That the recommended safety performance criteria and safety thresholds for the safe operation and maintenance of the Works have been met.
- (3) That the standards and specifications upon which the safe operation and maintenance of the Works are based have been met.
- (4) That the safe systems of work, rules and procedures required to operate and maintain the Works within the defined parameters of risk as approved in the "Design/Systems Safety Report" have been verified.

12.20 SYSTEM ASSURANCE DURING TRIAL RUNNING

12.20.1 Activities

The period of Trial Running shall include as a minimum the following activities:-

- (1) Demonstration of system performance and adherence to timetables by running a simulated revenue service at progressively increasing levels of service.
- (2) Evaluation of the effectiveness of normal operating procedures including those that deals with minor disruptions and staff unavailability.
- (3) Evaluation of the effectiveness of system fault reporting, fall back systems, operating procedures and maintenance responses in the event of a number of system failures and degraded operating scenarios by simulating such scenarios during simulated revenue service.
- (4) Evaluation of the effectiveness of operating procedures and other incident management responses in the event of a serious incident including but not limited to fire by simulating such scenarios during simulated revenue service.

12.21 SYSTEM ASSURANCE DURING REVENUE SERVICE RUNNING

12.21.1 General Requirements

The Contractor shall continue to implement system assurance activities during and after the transition to revenue service including, but not limited to, the following requirements.

- (1) Revenue Service shall not commence until the "Proof of Safety" has received the approval of the Employer.
- (2) During the Defects Correction Period, day to day monitoring of the Railway RAM performance shall be carried out and the findings shall be used to enable systematic means of data analysis and recording of the RAM performance.
- (3) In the event that a defect/failure shall arise, the Contractor shall provide full technical support in failure investigation and rectification.
- (4) The Contractor shall employ suitable mechanisms and develop a suitable organization structure in conjunction with the Employer to support ongoing RAM activities.
- (5) The Contractor shall provide support to the Operator to ensure that the documentation and processes defined in the Ongoing Management of Safety document have been fully assimilated into the Operator's Safety Management System and organization.

12.22 SYSTEM ASSURANCE DURING DEFECT NOTIFICATION PERIOD (DNP)

12.22.1 Defect Notification

The Defect Liability /Notification Period shall be of 36 Months from the date of Taking Over of works and shall be monitored for RAMS compliance. The Failures and Performance shall be monitored on monthly basis and the result should meet the acceptable criterions. If the results of 6 months average do not meet RAM specifications than the DNP period shall be extended with full DNP obligations of the Contractors. The same may be extended with /without penalty for further period similarly.

12.22.2 DNP - Major Activities

During the Defect Notification Period (DNP) of the project, the following activities shall be carried out by the contractor:

- (1) Keep full records of any failures and the actions taken to restore the equipment to full service and input the record data in the FRACAS for the FRB panel to evaluate.
- (2) During this period the Contractor shall replace/ remedy from his resources the defects occurring under normal usage of Works by the Employer except for normal wear and tear under such usage.
- (3) During Defect Notification Period, Contractor shall maintain the required spares and Tools and Plants at identified place as agreed with the Employer's Engineer. The Contractor shall not utilize any spares intended to be delivered to the Employer.
- (4) The Contractor shall maintain a qualified team of the required technicians and Engineers to meet DNP obligations. The Contractors shall submit a Manpower Plan showing the Contractor's organization available during Defect Liability Period.
- (5) The Contractor shall attend the periodic FRB Meeting with the Employer/Engineer to discuss the defects arising during the Defect Notification Period. The dates and agenda of the meeting shall be as per the consent by the Engineer.
- (6) If the Contractor fails to remedy any defect or damage within a reasonable time, a date may be fixed by (or on behalf of) the Employer, on or by which date the defect or damage is to be remedied. The Contractor shall be given reasonable notice of this date.

12.23 SYSTEM ASSURANCE SUBMISSIONS

12.23.1 Deliverable Documents

The Contractor shall implement and submit system assurance supporting documents in accordance with the approved System Assurance Plan. The Contractor shall implement and submit system assurance supporting documents in accordance with the approved System assurance plan.

**Part-2, Section VII-1: Employer's Requirements - General Specifications (GS)- 2x25 kV AC
Traction Electrification and associated work**

S No	Document Description	Plan Development Stage					Remarks
		Design Stage		Manufacture/ Construction h/Installation	Testing/ Trial Run Stage	Warranty Stage	
		PRELIM	FINAL				
1	System Assurance Plan (included System RAM Plan and System Safety Plan)	P					Shall be submitted within 90 days from the commencement date.
2	System RAM Plan		U	U	U		
3	System Safety Plan		U	U	U		
4	Safety Policy	P					Shall be submitted within 90 days from the commencement date.
5	Hazard Analysis and Hazard Log	P	U	U	U	U	First report shall be submitted within 14 days after the preliminary design completion. The report to include Safety Requirements Specifications and Safety Critical Item List (SCIL).
6	Design/ Safety Studies and Report		P	U	U		First report shall be submitted within 14 days after the final design completion. The report shall at least include the Safety Requirement Specification, Hazard Log, Deterministic Safety Assessment, Quantitative Risk Assessment, Safety Integrity Level Analysis, Failure Mode, Effect and Criticality Analysis, Reliability Block Diagram
7	RAM Analysis and Prediction Report		P	U	U	U	First report shall be submitted within 14 days after the final design completion.

**Part-2, Section VII-1: Employer's Requirements - General Specifications (GS)- 2x25 kV AC
Traction Electrification and associated work**

8	FMECA		P	U	U	U	First report shall be submitted within 14 days after the final design completion.
9	RAM Test / Demonstration Plan		P	U	U	U	First report shall be submitted within 14 days after the final design completion. The demonstration plan shall include the proposed FRACAS system.
10	RAM Test / Demonstration Report				P	P	- Reports shall be submitted separately within 14 days after each completion of demonstration tests in terms of maintainability demonstration test, and availability / reliability demonstration test. - Monthly RAM Demonstration Records and Reports shall be submitted on 7 th day for preceding month ended during Operations Period.
11	Engineering Safety Validation Plan		P	U	U		First report shall be submitted within 7 days after the final design completion.
12	Engineering Safety Validation Report				P		Shall be submitted within 7 days after completion of safety validation test.
13	Operational Safety Case	P			P		Second report shall be submitted within 7 days after the completion of safety validation test.

P - Document Produce
U - Document Update

(End of Chapter 12)

CHAPTER 13 - TRAINING AND SERVICE LIFE SUPPORT

13.1 GENERAL

13.1.1 Training Requirements

- (1) The Contractor shall provide comprehensive training to the Employer's Personnel in respect of design, system engineering, construction/ installation, assembly, configuration, operations, fault diagnosis and maintenance of the systems/sub-systems, provided under the Contract.
- (2) The Contractor shall arrange training at units/places/ works where the greatest benefit shall accrue to the trainee engineers w.r.t. design, system engineering, and assembly, installation, configuration, testing & fault diagnosis. The Contractor shall arrange Training at manufacturer's premises as well at site, as per the approved Training Plan and also as specified in respective Particular Specification.
- (3) The Employer's Key Instructors shall attend all types of training courses so that they shall be able to subsequently train the Employer's staff in future in all aspects of operation and maintenance of the System.
- (4) The Contractor shall also arrange training at site for the trainee operational staff and maintenance staff. The Contractor shall set up training class rooms/use conference hall(s) near to site, where he shall provide competent training instructors, training manuals, all necessary aids/ demonstrable examples and materials as required for all the training courses. The training courses at site shall cover working principles, installation, operation, fault diagnosis & maintenance of all major equipment and works engineered by the Contractor. All the training courses at site shall be conducted during installation period and completed before the commencement of testing and commissioning. Such training courses shall be held at a venue to be arranged by the contractor at his cost. The Employer, may, however, permit the use of the rooms if available with him free of cost.
- (5) The training instructors, for training courses, shall be qualified, competent, with sufficient years of practical experience and possess good communication skills in the relevant fields. The training shall be in the English / Hindi languages as required. All training material for these courses shall be in English / Hindi as required.
- (6) Should, in the opinion of the Engineer and due to good reasons, any of the Contractor's training instructors not considered competent or not to have a suitable attitude or aptitude for carrying out the training courses for whatever reason, the Contractor shall remove the said person and replace him as soon as possible with an acceptable substitute.
- (7) The Contractor shall provide full-time management, co-ordination and supervision of the entire training Program to ensure the continuity of classes and proper distribution of training materials and be responsible for interfacing with the instructors.
- (8) The Contractor shall bear all the Training costs except for allowances, hotel and travel expenses of the Employer's trainees.

13.1.2 Training Plan

- (1) The Contractor shall prepare and submit a Training Plan to the Engineer for review.
- (2) The Training Plan shall include as above, but not be limited to:
 - a. the program of the training courses at OEM's Works and at site;
 - b. overview and description of objectives of each training course;
 - c. the location where the training courses to be conducted;
 - d. submission schedule of the training materials;
 - e. set ups for practical exercises;
 - f. the Contractor's training organisation chart, including the role and responsibilities of individual key persons;
 - g. the qualifications and experience of the training instructors;
 - h. duration of training for each module,
- (3) The Training shall be imparted both at the manufacturer's premises as well as at the site. The duration of the training at manufacturer's premises and/or at the work site is detailed in the PS, Section VII-2 for Electrical (PSI, OHE, ROCS and SCADA).

13.1.3 Training Courses

- (1) The Contractor shall provide Training Courses on all facilities, systems, equipment, hardware, firmware and software. Each Course shall be specific and shall consist of classroom, hands-on and/or field training as necessary to accomplish the Course Objectives specified in the Training Program Plan. The Contractor shall develop detailed training modules based on information in the Operating and Maintenance manuals.
- (2) The technical training courses to the Employer's staff shall be programmed in phases with the progress of manufacture and installation to ensure that trainees are present during all stages of the manufacture, installation and commissioning of the equipment which is the subject of the training. The Contractor shall ensure that the courses fully encompass all aspects of the basic design, manufacture, installation, commissioning and maintenance of the Equipment with maximum effort being directed at instruction in the maintenance of the installations.
- (3) Training at site shall include operation courses and maintenance courses. The class will be of maximum of 30 trainees. The Contractor in consultation with Engineer and Employer shall determine the number of classes for each type of training course, within the provisions available in respective Particular Specification, to ensure the objectives of the course can be met.
- (4) **Training Course for Operating Staff**
 - a. The training courses for operation staff at site shall be developed to provide all necessary knowledge and skills for operations staff of the Employer for operating the system under normal and emergency situations and recovery from minor or simple faults. In particular, the training course shall include the following as minimum:
 - (i) overview of the system/sub-system;

- (ii) brief description of the operation principles of the system/sub-systems;
 - (iii) operational features and functions;
 - (iv) familiarisation and use of all man-machine interfaces involved;
 - (v) reading and interpretation of system status and alarm messages or indications;
 - (vi) normal operating procedures;
 - (vii) operating procedures under emergency situations;
 - (viii) procedures for recovery from minor or simple faults; and
 - (ix) use of Operation Manuals and documentation.
 - (x) A comprehensive list of Dos and Don'ts shall be prepared and explained to the operating personnel and also shall be prominently displayed at site.
- b. Particular exercises shall be included in the training course for operation staff at site for each trainee to operate and manage the system under normal and emergency operating conditions and simple faults recovery.
- (5) **Training Course for Maintenance Staff**
- The training courses for maintenance staff at site shall, as a minimum, impart the following techniques to maintenance staff of Employer of the appropriate grades:
- a. All planned maintenance and overhaul of the systems supplied & installed;
 - b. Fault finding and rectification techniques for the systems/subsystems including equipment supplied, installed or modified under the Contract. These shall be developed from the Contractor's previous experience with similar equipment and also from the fault tree analysis and other analysis carried out as part of the reliability engineering studies undertaken by the Contractor;
 - c. Normal and degraded modes of operation of the HOCR systems/subsystems including equipment supplied, installed or modified under the Contract;
 - d. All rules, regulations, practices and procedures necessary for the safe & efficient operation of the systems supplied, installed or modified under the Contract; and
 - e. All contingency plans necessary to recover speedily and safely from any mishaps or emergencies that may arise with the HOCR systems supplied and installed or modified.
- (6) The Contractor shall provide all training material including presentations, mock-ups, models, tables, chairs, white boards, and so on.
- (7) The Training during operation courses and maintenance courses shall enable trainee operation and maintenance staff to achieve Competency Certificate from the competent authority.
- (8) The training courses for system engineers at manufacturing facilities shall be developed to provide all necessary knowledge and skills to perform system engineering management including system parameter configuration,

enhancement, expansion and provision of new circuits.

- (9) The Contractor shall determine the content of the system engineering courses, however the courses shall include the following as minimum:
- a. overview of the system/subsystem;
 - b. background theory;
 - c. system features and functions;
 - d. system configuration and operation principles;
 - e. description of system components and equipment down to card or module level;
 - f. test and commissioning procedures;
 - g. use of test equipment and special tools;
 - h. reading and interpretation of alarm indications, messages and print-outs;
 - i. preventive maintenance procedures;
 - j. fault diagnosis, troubleshooting and corrective maintenance procedures;
 - k. equipment settings and parameters configuration;
 - l. use of equipment manuals, Operation and Maintenance manuals, circuit diagrams and wiring schematics;
 - m. methods and procedures to provide new circuits, system expansion and enhancement;
 - n. data, software backup and loading; and
 - o. use of software such as peripheral control and configuration, utility, database structure, generation and modification.
 - p. Periodical Maintenance schedules and impacts;
 - q. Familiarisation and use of all man-machine interfaces involved;
 - r. Normal operating procedures;
 - s. Operating procedures under emergency situations; and
 - t. Procedures for recovery from faults
- (10) During the Defects Notification Period, when the Contractor is responsible for faultfinding and repair, he shall provide practical hands on training to Employer maintenance staff to facilitate successful handing over of the works.

13.1.4 Training Material and Equipment

- (1) With the prior approval of the Engineer, the Contractor may use the Works being erected, tested or commissioned for the training of Employer Personnel.
- (2) Training course notes shall be entirely compatible and where appropriate, cross-referenced to the manuals supplied by the Contractor as part of the Operation & Maintenance documents.
- (3) The Contractor shall provide such written or printed matter, functional equipment, samples, models, cutaway equipment, slides, films and other instructional material, as may be necessary for training. Such equipment and material shall remain the property of the Employer and shall be sufficient both for the persons trained by the

Contractor and for those to be subsequently trained by Employer Training Instructors.

- (4) The Contractor shall provide an instructor's guide for each training course. The guide shall include the course agenda, objectives, list of resources and facilities required, detailed lesson plans, presentation notes, discussion guides, training aids and job aids, test papers, criteria and methodology for testing and assessment, and all other things that will enable Employer's Training Instructors to carry out repeat or refresher courses in the future.
- (5) At the commencement of the training course, the Contractor shall, distribute two sets of Trainer's guides in hard copy and one set of Training manual in hard copy for each trainee. Contractor shall supply three sets of Trainer's guides and three sets of Training manual in hard copy as well as in editable softcopy to the Engineer.
- (6) All training course notes and instructor's guides shall be submitted to the Engineer for review three (03) months prior to the commencement of the first training session of the course.
- (7) All training course notes/instructor's guides shall be in easy reproducible form.
- (8) All training course notes/instructor's guides shall be in format as decided by the Engineer.

13.1.5 Training Course Evaluation / Test and Assessment/Training Records

- (1) The Contractor shall develop a system for assessment and certification of trainees to assess and verify their proficiency in the subjects being trained. The assessment and certification procedures shall be submitted to the Engineer for approval. At the end of the training period, the Contractor shall issue 'training certificate' to the trainees participated. Training sessions, tests, and certification processes may be witnessed by the Engineer and the Employer's Personnel.
- (2) The Contractor shall develop questionnaires to trainees for each training course in determining the level of satisfaction with the course content. Appropriate scoring weighting shall be assigned to each question in the questionnaires such that the scores shall reflect the trainee's satisfaction to the training course. The questionnaires shall be submitted to the Engineer for review four weeks before the commencement of the training course.
- (3) The contractor shall submit the course evaluation criteria to the Engineer for approval.
- (4) The Progress of Training shall be evaluated by the Engineer at regular intervals for adequacy and arrangement of training. Items that require further information or tasks that require additional training or practice will be discussed between Engineer and the contractor at the evaluation meetings. Such items or tasks must be appended to the training Program as soon as possible.
- (5) The Contractor in consultation with the Engineer, shall develop a system of Feedback after each Training course. The Feedback forms shall measure the Trainee's level of satisfaction with the course content. The Feedback form shall be submitted to the Engineer for review four weeks before the commencement of the Training course.
- (6) After two weeks, the Contractor shall submit a Training report to the Engineer for

review. The Training report shall include a summary of the training course conducted, training course title, date of training, the results of trainees' assessment and the Feedback report including attendees, trainer and training material.

13.2 SERVICE LIFE SUPPORT

- 13.2.1 The Contractor should ensure availability of full support to the Employer for operation, maintenance, customization and up gradation of system/sub-system supplied and installed by him as part of the Contract.
- 13.2.2 The Contractor shall undertake to provide, if required during the life of the equipment provided under Contract, technical assistance in the form of additional drawings, maintenance practices and technical advice (including training).
- 13.2.3 For all imported systems/subsystems, the Contractor must ensure:
- a. Establishment of Servicing facility in India.
 - b. Establishment of Customization facility to add/modify/re-engineer hardware/software of the subsystem as required by the Employer during the lifetime of the equipment for adding facilities including up gradation etc.
 - c. Establishment in India to undertake Annual Maintenance Contract (AMC) during the service life of the equipment.
 - d. Supply of Spares for entire service life of the equipment.
 - e. Supply additional equipment required for replacement or expansion of the network in future.
 - f. Training of Employer's Personnel to reach qualified levels for operation and maintenance.
- 13.2.4 The Local Service Centre shall have test and repair facility with simulation test set-up, fault diagnostic system, test jigs, software for testing of cards/modules along with required test instruments and tools.
- 13.2.5 The Contractor/OEM of the system/subsystem shall be required to undertake comprehensive Annual Repair Contract (ARC) at the end of Defect Notification Period. The comprehensive ARC may include supply of cards/modules for repairs/replacement of the sub system/system.
- 13.2.6 The contractor shall ensure that the OEM should either provide support as above on his own or sign an MOU with suitable Indian companies or company having proven track record and are working in related areas for all imported systems/subsystems. The copy of the MOU shall be submitted to the Employer as a proof of continuous support.
- 13.2.7 The sub systems/systems of OEMs who are for complete Transfer of Technology (TOT) including system assembly, manufacturing, installation, maintenance and software modification/customization, training etc. shall be preferred for use by the Employer. In such case, the contractor shall submit the detailed plan for progressive manufacture of imported items by OEM in India.
- 13.2.8 Cost of any supply / service provided by the Contractor / OEM beyond DNP /extended guarantee period (wherever applicable), shall be borne by the Employer.

(End of Chapter 13)

CHAPTER 14 - OPERATION & MAINTENANCE & SPARES

14.1 GENERAL

- 14.1.1 Operation and Maintenance is an important element in the execution of a project. It is essential to have a well-designed Operation & Maintenance Support Plan and Maintenance Plan before the system is made Operational. These plans shall be submitted to Engineer for review, at least six months before start of Defect Notification Period.
- 14.1.2 It shall be ensured that the resource requirement in terms of men and material as identified in the Plans is available before the system is made Operational.
- 14.1.3 The Contractor shall repair and/or replace, in each case at no cost to the Employer, any part of the Works which is found to be defective by reason of faulty design, materials or workmanship or negligence or failure on the part of the Contractor to comply with any obligation expressed or implied under the Contract, during the DNP after the date of issue of the Taking Over Certificate of the Works. The Works shall also include equipment being provided under Contract Package SYS-1 which shall be upgraded/augmented/reconfigured, under this Contract if so required.
- 14.1.4 During the Defects Notification Period, as a result of an inspection made by or on behalf of the Employer at any time or times prior to its expiration, the Engineer shall have the right but not the obligation to instruct the Contractor in writing to execute all such work of repair, amendment, rectification and make good defects, imperfections or other faults in the Works and any part thereof, as the case may be.

14.2 OPERATION & MAINTENANCE PLAN

- 14.2.1 The Contractor shall prepare and submit Operation & Maintenance Plan for review by the Engineer. Operation and Maintenance Plan shall cover, but not limited to, the following items:
- (1) Submission of Technical Manuals as per respective Particular Specification;
 - (2) Submission of Operation & Maintenance Manuals for each item/unit/equipment as per respective Particular Specification;
 - (3) Submission of procedures for preventive & corrective maintenance, overhaul / renewal and for handling break-downs.
 - (4) Requirement of Employer's Manpower for maintenance;
 - (5) Proposed Contractor's Manpower for Supervision of Maintenance during Defect Notification Period;
 - (6) Operation & Maintenance training requirements for Employer's Personnel ;
 - (7) Provision of Software Support during 'Defect Notification Period';
 - (8) Provision of Spares, Test Equipment, Tools, etc. as per respective Particular Specifications;
 - (9) Requirement of periodic operation of equipment and machines which would otherwise deteriorate because of non-operation for extended periods;

14.3 SUPPORT DURING DEFECT NOTIFICATION PERIOD (DNP)

14.3.1 Support and Call-out Services

- (1) The Contractor shall provide the Support & Call-out-services for maintenance of the system. The maintenance will be done by the Employer with the support of the Contractor. The Support and Call-out services shall be available 24 hours per day and 7 days per week.
- (2) The Contractor shall deploy adequate, committed and competent resources for providing desired level Support and Call-out-services. As a minimum, the expert of each sub-system shall be provided by the contractor at every major location and at PSI and OHE depots. All the resources shall be trained before deployment.
- (3) The resource deployment shall be as per Operation and Maintenance Support Plan approved by the Engineer. The Contractor shall provide a list of staff together with the contact landline/mobile telephone numbers who can be contacted for Support and Call-out-services. Any change in the staff or his call-out number shall be notified to the Engineer at least two weeks before such change becomes effective.
- (4) The Contractor's response Time for Support & Call-Out-Services shall not exceed one hour. The Response Time is defined as the time that elapses between the reporting of a fault and the Contractor's Call out personnel arriving at site where the faulty equipment is located.
- (5) In case of any abnormal System behavior like intermittent faults, interference, frequent repeated faults, etc. occur or the performance is found to deviate from the specified tolerances, the Contractor shall conduct investigations and report the findings to the Engineer along with the recommendations and proceed after the recommendation has been reviewed without objection by the Engineer. The Contractor shall take every precaution to protect existing equipment from damage and make good any damage caused.

14.3.2 Workshop Repair

- (1) The Contractor shall provide Workshop repair services for all defective and faulty items of the System and shall collect and repair defective parts that are removed from the System during corrective and predictive maintenance.
- (2) The Contractor shall perform all necessary adjustments or alignments as required to the repaired parts. The repair of defective parts can only be considered as completed and returned to stock or back to the System if the parts are tested and verified fit for use in the System.
- (3) The Contractor shall use only components of equal or better specification than the original components in his repair activities. The performance of the defective parts after repair shall not be degraded or deteriorated due to repairs.
- (4) The maximum turnaround time for workshop repair shall be less than 28 calendar days. The turnaround time count shall start from the time the defective parts are removed from the System and shall continue till the parts are repaired and returned to stock or to the System. Any extension of workshop repair time shall be agreed with the Employer.

14.4 EXTENSION OF DEFECT NOTIFICATION PERIOD

- 14.4.1 In case of failure of the Contractor to achieve the RAMS Targets specified in the Employer Requirement:
- a) The Defects Notification Period shall stand extended for a further period corresponding to period of failure;
 - b) The Performance Guarantee shall stand extended for a period corresponding to the extension of the Defects Notification Period; and
 - c) All work required to be carried out by the Contractor for the rectification of defects, shall be carried out at the Contractor's own expense.

14.5 OPERATION AND MAINTENANCE (O&M) MANUALS

14.5.1 In addition to the various existing Codes and Manuals applicable to Indian Railways for operation and maintenance of systems such as Traction Power Supply, OHE system, ROCS system and SCADA etc., the Contractor shall produce Manuals covering the additional provisions, over and above the various existing Codes and Manuals of Indian Railways in respect of the Operation and Maintenance requirements of various assets created under the Contract.

14.5.2 With reference to the requirements as above:

- (1) The Contractor shall produce manuals for all equipment and manufactured items and sub-systems, supplied and created under the Contract, for their efficient operations and maintenance. These shall include, but not be limited to, the following manuals:
 - a) Maintenance of Traction Power Supply Equipment;
 - b) Maintenance of Traction OHE Equipment's;
 - c) Maintenance of Traction ROCS Equipment;
 - d) Maintenance of Traction SCADA System;
 - e) Maintenance of Buildings & Structures including lighting etc.;
 - f) Earthing & Bonding, Lightning and Surge Protection System
 - g) System / Sub-System Manuals- A comprehensive description of all system principles at block diagram level.
 - h) Operating/User Manuals - broken into as many sub-sections as necessary and providing sufficient information to enable non-technical staff to exploit fully the facilities of each system.
 - i) Workshop Manuals - Installation and circuit descriptions, full schematics, circuits, wiring diagrams, mechanical construction/installation drawings and itemized parts list to enable all maintenance rectification and setting-up to be carried out.
 - j) Software System Manual - for each software package and each piece of equipment which incorporates Programmable Device(s), licensed copies of CD/DVD/Hard Disc of application and peripheral software along with write up on software features, instructions for configuration, working of software and procedures for taking out report and data in the form of instruction

- manual/guide.
- k) As-Built Documents - all wiring diagrams and circuits, equipment layout, terminal and cable listing and including such external equipment as may be necessary for completeness.
- (2) Maintenance Manuals shall contain the following but not limited to;
- a) Technical description, principle, installation procedures etc., of each system and sub-system of equipment installed to ensure that the Employer's technical staffs fully understand the scope and facilities provided.
- b) Diagrammatic drawings of each system indicating principal components and items of equipment
- c) Name, addresses, telephone, e-mail and fax numbers of the manufacturer of every item of equipment
- d) Manufacturer's service manual for each major item of equipment, assembled specifically for the project including detailed drawings, illustrations, circuit details, operating and maintenance instructions, modes of operation, control provisions, sequences and interlocks and preventative maintenance Program.
- e) Procedures for fault localization and isolation
- f) Maintenance procedures and their periodicity. The contractor must give list of Items to be checked, adjustments to be made, safety checks to be performed and frequency of maintenance for each item of the sub-system/equipment. These maintenance Schedules should be compiled in the form of a register and shall be kept at stations for recording of the maintenance done by maintainer. It should lead to computerization of the maintenance activities.
- g) Tools and Plant needed for maintenance of different Equipment provided in the Works.
- h) Configuration Manual for all equipment, wherever required.
- i) All test results conducted on the relevant equipment whether at the manufacturer's place or at site; and
- j) Manufacturers' lists of recommended spare parts for items subject to wear and deterioration, giving expected running period and indicating specifically those items, which may involve extended deliveries.
- (3) The Operating / User Manuals and Maintenance Manuals of Systems/Sub Systems suitable for use at technician level, shall be prepared in both English and Hindi languages unless otherwise instructed by the Engineer.
- (4) The Contractor shall provide 6 copies (hard copy) of all Manuals along with editable (and pdf) electronic version for the use of the Employer's Staff / Engineer.
- (5) The Contractor shall maintain all Manuals in an updated condition throughout the Contract Period, wherever applicable.
- (6) O&M Manuals and drawings as submitted by the Contractor shall be updated by him during the Defects Notification Period, if required and shall be re-submitted to the Engineer for review without any extra cost to the Employer.

14.6 MAINTENANCE PLAN

- 14.6.1 While Operation & Maintenance Support Plan take care of day to day operation and maintenance of the systems/sub-systems, the Maintenance Plan is designed to put the maintenance practices on sound footing for proper upkeep of the systems. The Maintenance Plan shall be prepared by the Contractor and submitted to the Engineer for review at least 12 months before start of Defect Notification Period.
- 14.6.2 The Maintenance Plan shall describe, but not limited to, the following:
- (1) Maintenance philosophy and approach,
 - (2) All necessary tasks for first line, second line, third line and corrective maintenance,
 - (3) Frequency of each maintenance task,
 - (4) Employer's and Contractor's proposed maintenance regime for maintenance,
 - (5) Maintenance Schedules (Daily, Weekly, Monthly) detailing maintenance task for each maintenance team member;
- 14.6.3 The Maintenance Plan shall be aligned with the Employer's maintenance policy.

14.7 MAINTENANCE SCHEDULES

- 14.7.1 The Contractor shall prepare the Maintenance schedule for each item/equipment required to be maintained. The schedule should give the details such as the frequency of maintenance, the items to be maintained, the tolerances permitted and the safety checks to be performed. The Contractor shall submit the Maintenance Schedule to the Engineer for review.
- 14.7.2 In addition to the above, the Contractor shall include in the Maintenance Schedule the following information:
- (1) The equipment, sub-systems covered in the task,
 - (2) Step by step procedure to carry out the task,
 - (3) Tools and test equipment required for each task,
 - (4) Diagrams and flowcharts by illustration, if applicable,
 - (5) Adjustment procedures for all field adjustable units,
 - (6) Recovery procedures, if applicable,
 - (7) Precautions to be followed by maintenance personnel and
 - (8) Estimated duration and manpower required;
 - (9) Test to be conducted on System/Sub-System;
 - (10) Do's & Don'ts

14.8 MONTHLY MAINTENANCE MEETING

- 14.8.1 The Contractor shall attend the Monthly Maintenance Meeting with the Engineer to discuss the maintenance matters during the Defect Notification Period. The dates and agenda of the meeting shall be agreed with the Engineer.

14.9 SOFTWARE SUPPORT

- 14.9.1 The Contractor shall provide full support to the Employer and the Engineer for all computer programs, which are supplied by the contractor under the scope of this Contract.
- 14.9.2 The Contractor shall provide to the Employer and the Engineer one (1) copy each of the software packages with the same software products as those that the Contractor intends to use for the project, inclusive but not limited to programs for business administration, project management, design development etc. The Contractor shall utilize a shared electronic document management system with the Engineer and the Employer which shall be web / internet based.
- 14.9.3 The Contractor shall provide all tools, equipment, manuals and training necessary for the Employer/Engineer to maintain, re-configure and to make proper use of all the software provided under the Contract. This shall include supply of any specified development tools required for maintenance of the software, including but limited to editors, compilers and linkers.
- 14.9.4 If any software is developed under the Contract or used by the Contractor for the purposes of storing or utilizing records over which the Contractor or a third party holds title or other rights, the Contractor shall permit or obtain for the Employer and Engineer the right to use the Software free of any additional charge, together with any modifications, improvements and developments thereof, for the purpose of the reinstatement, extension, repair, modification or operation of the Works, or any part thereof, or to avoid any Dispute.
- 14.9.5 The Contractor's permission referred to above shall be given, inter-alia, to enable the Employer to disclose (under conditions of confidentiality satisfactory to the Contractor) program and documentation for a third party to undertake the performance of services for the Employer in respect of such program and documentation.
- 14.9.6 The Contractor shall submit a Software support plan at least ninety (90) days before commencement of software installation. This plan shall require the Contractor to provide all changes, error fixes, updates, modifications, amendments and new versions with the updated instructions, and Operation and Maintenance Manuals of the program as required.
- 14.9.7 The Contractor shall submit all new versions to the Engineer for review at least two (02) weeks prior to their installation. The Engineer will not be obliged to use any new version and this shall not relieve the Contractor of any of its obligations.
- 14.9.8 The Contractor shall:
- (1) ensure that all new versions are fully tested & commissioned at site and validated on the simulation and development system and reviewed without objection by the Engineer prior to installation;
 - (2) All new version of software shall be accompanied by a release note containing the following details:
 - a) Version number
 - b) Modifications made to the previous version
 - c) Check sum;

- d) Updated Operation & Maintenance manuals
- 14.9.9 The new Versions of any program shall not result in any non-conformance with the Specification or degrade the performance or have adverse impact on the System. Any effect upon the performance or operation of the computer-controlled system that may be caused by a new version shall be brought to the Engineer attention including updating the files to suit new version.
- 14.9.10 The Employer reserves the right to use other Software in connection with the Works.

(End of Chapter 14)

CHAPTER 15 - APPENDICES

This Chapter includes a number of Appendices as listed below:

APPENDIX 1 –MONTHLY PROGRESS REPORT

APPENDIX 2 - DRAWINGS AND CAD STANDARDS

APPENDIX 3 - DESIGN CERTIFICATES

APPENDIX 4 - TEMPORARY WORKS

APPENDIX 5 - REQUIREMENTS FOR CONSTRUCTION

APPENDIX 6 - ENVIRONMENT PROTECTION REQUIREMENTS

APPENDIX 7 - PMIS REQUIREMENTS AND PROCEDURES

APPENDIX 8 – LIST OF LEVEL CROSSING

APPENDIX-9: ENVIRONMENTAL, SOCIAL, HEALTH AND SAFETY PROGRESS REPORTS

APPENDIX 10 – LIST OF BRIDGES

APPENDIX 11 – LIST OF TRANSMISSION LINES 66kV AND ABOVE

APPENDIX 12 – LIST OF POWER CROSSINGS 33KV AND BELOW

APPENDIX 13 – SUBCONTRACTOR FOR ROCS SYSTEM

APPENDIX 14 – CONTRACTOR'S KEY PERSONNEL

APPENDIX 15 – KEY DATES

APPENDIX-1: MONTHLY PROGRESS REPORT

1. GENERAL

- a. The Contractor shall prepare and submit Monthly Progress Reports in at least 5 Copies (hard) in English as well as in Electronic Medium or CD covering all aspects of the execution of the Works.
- b. Monthly Progress Reports shall be delivered to the Engineer by the 7th day of the month reporting the progress of the work performed from 1st day of the previous month till the Last day of previous month to which the Monthly Progress Report relates.
- c. The Monthly Progress Report shall contain evidences that documents and supports indicating the progress of the Works, as stated in the interim Certificate of Payment, to the satisfaction of the Engineer.
- d. The reports, documents and data provided shall be an accurate representation of the current status of the Works and of the work to be accomplished and shall provide the Engineer with a sound basis for identifying problems and deviations from planned work and for making decisions.
- e. The results of quality audits shall be summarized in the Contractor's monthly reports.
- f. Monthly Progress Report format, as approved by the Engineer shall comprise the following information:
 - i. Executive Summary
 - ii. Achievements of the month
 - iii. Top 10 significant issues
 - iv. *Environment, Social, Health and Safety Compliance*
 - v. Quality Assurance Issues
 - vi. Design / Engineering Status
 - vii. Procurement Status Report (i.e. statement with PO date, Manufacturer name, LC date, FAT test date, Shipping / Dispatch date, Delivery date)
 - viii. The Status (Manufacturing / Supply / Installation / Testing) of stages of Works i.e. Physical Progress of activities
 - ix. Work Program Progress status
 - x. Any delay/ shortcomings from the Targets, constraints and Measures Proposed
 - xi. Financial Progress Status
 - xii. Progress marked on 3 month's rolling Program
 - xiii. Assistance Required if any

2. ESHS

A review of all *ESHS* aspects during the month including reports on all accidents and actions proposed to prevent further occurrence including details of *ESHS*

training and drive conducted during the period and proposed in coming months.

3. FINANCIAL STATUS

- (1) A narrative review of all significant financial matters and actions proposed or taken in respect of any outstanding matters.
- (2) A spread sheet indicating the status of all payments due and made including recoveries, if any.
- (3) A report of the status of any outstanding claims even if these are NIL.
- (4) The report shall in particular provide interim updated accounts of continuing claims.

4. PHYSICAL PROGRESS

- (1) It shall describe the status of work performed in descriptive form, significant accomplishments, including critical items and problem areas including current and anticipated delaying factors and their impact, corrective actions taken or planned and other pertinent activities and shall, in particular, address interface issues with all agencies involved, problems and resolutions during the period or anticipated.
- (2) It shall include a simplified representation of progress measured in percentage terms compared with percentage planned as derived from the Works Program.

5. PROGRAM UPDATE FOR ENTIRE PROJECT

- (1) Program updating shall include:
 - a. The monthly program update which shall be prepared by recording actual activity completion dates and percentage of activities completed up to the last day of the month and expected activity completion based on current progress.
 - b. The Program update shall be accompanied by an activity report and a narrative statement.
 - c. The narrative statement shall explain the basis of the Contractor's submittal:
 - i. Early Work and baseline submittals – explains determination of activity duration and describes the Contractor's approach for meeting required Key Dates as specified in Chapter- 4:" Project Program Requirements" of this GS
 - ii. Updated detail program submittals – state in the narrative the Works actually completed and reflected along critical path in terms of days ahead or behind allowable dates, specific requirements of narrative are:
 - If the updated detailed work program indicates an actual or potential delay to Contract Completion date or Milestones, identify causes of delays and provide explanation of work affected and proposed corrective action to meet Milestones or mitigate potential delays.
 - Identification of any deviation from previous month's critical

path.

- Identify by activity number and description, activities in progress and activities scheduled to be completed.
 - Discuss variation work order items, Value Engineering items, if any.
- b. Program Status which shall:
- i. Show Works Program status up to and including the current report period, display cumulative progress to date and a forecast of remaining work.
 - ii. Be presented as a bar-chart in size A3 or A4.
- c. The activity variance analysis which shall analyze activities planned to start prior to or during the report period but not started at the end of the report period as well as activities started and/or completed in advance of the Works Program.

6. THREE-MONTH ROLLING PROGRAM

The three month rolling program shall be issued on a monthly basis.

7. PROCUREMENT REPORT

- (1) A summary of all significant procurement activities during the month, including action taken to overcome problems.
- (2) A report listing major items of plant and material which will be incorporated into the Works.
- (3) The items shall be segregated by type and the report should show as a minimum the following activities:
 - a. Purchase order date - scheduled/actual;
 - b. Manufacturer/supplier and origin;
 - c. Letter of credit issued date;
 - d. Manufacturer/supplier ship date - scheduled/actual;
 - e. Method of shipment;
 - f. Arrival date in India- scheduled/actual.

8. PRODUCTION AND TESTING

- (1) A review of all production and manufacturing activities during the month.
- (2) Summaries of all production and manufacturing outputs during the month together with forecasts for the next month.
- (3) Review of all testing activities (both at Site and at the manufacture's premises) during the month

9. DEPLOYMENT OF MANPOWER MATERIAL AND EQUIPMENT AT SITE

- (1) Detail showing the extent of deployment of manpower, equipment and stock of

important construction material utilized at the Site.

- (2) A list of major construction equipment used on the Project during the reporting period and any construction equipment idle during the reporting period.
- (3) A list of all major or critical material and equipment, indicating current availability and anticipated job Site delivery dates.
- (4) The total number of personnel by craft actually engaged in the work during the reporting period, defined separately as to office, supervisory, and field personnel.
- (5) A manpower and equipment forecast for the upcoming twenty eight (28) days, stating the total number of personnel by craft, defined separately as to office, supervisory and field personnel.
- (6) Changes or additions to Contractor's supervisory personnel that occurred from the preceding Monthly Progress Report. The Monthly Progress Report shall accompany the Application for Payment and monthly schedule update

10. PROGRESS PHOTOGRAPHS AND VIDEOGRAPHY

- (1) The Contractor shall provide monthly progress photographs to demonstrate the progress of the works.
- (2) Two sets of photographs shall be provided on electronic storage device with two sets of Colour prints of 175 mm x 125 mm size.
- (3) All Photographs shall be labeled with the location and the date.
- (4) The Contractor shall ensure that no photography is permitted on the Site without the consent of the Engineer.
- (5) Construction/Installation activities working of machinery, weather effects or any occasion advised by the Engineer shall be video graphed. The recording shall be done or converted to .avi format and presented in electronic storage device with appropriate voice recording describing the event.
- (6) The Contractor shall provide to the Employer for every calendar quarter, a video recording, which will be compiled into a 3 (three) – hour compact disc or digital video disc, as the case may be, covering the status in that quarter giving progress of works. The first such video recording shall be provided to the Employer within 7 (seven) days of the LOA of the Contract and thereafter, no later than 15 (fifteen) days after the close of each quarter.

11. QUARTERLY AND YEARLY REPORT

- (1) The Contractor shall also submit Quarterly Progress Reports covering all aspects of the execution of the Works to the Engineer reporting the progress of the work performed between previous Quarters/Year.
- (2) The Progress Report shall contain evidences that documents and supports indicating the progress of the Works, as stated in the interim Certificate of Payment, to the satisfaction of the Engineer.

(End of Appendix-1)

APPENDIX-2 –DRAWINGS AND CAD STANDARDS

1. GENERAL

- (1) The purpose of this chapter is to define the Drawing and CAD standard and their standards for submissions, the acceptable file formats and content formats to help development of coordinated documents and drawings in common formats.
- (2) The titles & numbering, scale of drawings shall be as per relevant Indian Railway Manual/ IS Standards as well as above CAD standards as mutually agreed by the Contractor and the Engineer.
- (3) Drawings shall use as far as possible, symbols used internationally.
- (4) All legends, notes on drawings and schedules of material shall be in English and shall be prepared in the metric system
- (5) The Contractor shall submit six hard copies and a soft copy of the Detailed Design and drawings including calculations for review by the Engineer. After receipt of "Notice of No Objection" from the Engineer, the Contractor shall submit six (6) copies of the Design and / or Drawings for the use of the Engineer.

2. SOFTWARE

- (1) The following software compatible for use with Intel-Windows based computers shall be used unless otherwise stated, for the various electronic submissions required:

<u>Document Type</u>	<u>Electronic Document Format</u>
AutoCAD Graphics	CorelDraw, Ver. 12.0/ AutoCAD 2011 or latest versions
Photographic	Adobe Photoshop CS2 or latest version
Desktop Publishing	Page Maker 7.0 or latest version
CAD Drawings	AutoCAD 2011 or latest version.

- (2) For electronic file submission one copy shall be submitted unless otherwise stated on CD-ROM media. The media shall be CD-R and the recording method shall not allow any further changes to the recordable disk.
- (3) Internet File Formats/Standards:
 - a. The following guidelines shall be followed when the Contractor uses an internet browser as the communication media to share information with the Engineer /Employer. All the data formats or standards must be supported by Microsoft Internet Explorer version 7 or above running on Windows XP or above. The Contractor shall comply with them unless prior consent is obtained from the Engineer for a different data format:

<u>File Type</u>	<u>Data Format</u>
Photo Image	Joint Photographic Experts Group (JPEG)
Image other than Photo	GIF or JPEG
Computer Aid Design files (CAD)	Computer Graphics Metafile (CGM) and DWG

**Part-2, Section VII-1: Employer's Requirements - General Specifications (GS)- 2x25 kV AC
Traction Electrification and associated work**

Video	Window video (.avi)
Sound	Wave file (.wav)

- (4) The following states the standards to be used on the internet when connecting to database(s). The Contractor shall comply with them unless prior consent is obtained from the Engineer for a different standard:

<u>Function to be implemented</u>	<u>Standard to be complied with</u>
Database connectivity	Open Data Base Connectivity (ODBC)
Publishing hypertext language on the World Wide Web	Hyper Text Markup Language (HTML)

3. TITLE BLOCKS AND DRAWING NUMBERING

- a. The Contractor shall adopt a title block similar to that used in the drawings for all the Contractor's documents prepared under the Contract.
- b. Each document shall be uniquely referenced by a document number and shall define both the current status and revision of the drawing.
- c. The drawing numbers will be in the digits/format as defined Below:
Like PWL – SNP to define the section between Palwal to Sonapat,
 - i. X/X/XX/XXX-XXX/XXXX-X i.e P/4/OL/ PWL-SNP/0021-A
- d. The current status of each document shall be clearly defined by the use of a single letter code as follows:
 - i. A single letter character denoting the status of the drawings e.g.
 - T Tender Design
 - P Preliminary Design
 - W Working Drawing
 - M Manufacturing Drawing
 - S Site Drawing
 - D Shop Drawing
 - A As Built Document
 - ii. A single digit code denoting the contract number (for the whole line)
 - 1 Civil / Track Works from _____ to _____
 - 3 Systems Works
 - 4 Traction System – PSI
 - 5 Traction System – OHE/ROCS
 - 6 SCADA
 - iii. A two (2) letter code denoting the type of System Works or system elements e.g.
 - CG General Works

**Part-2, Section VII-1: Employer's Requirements - General Specifications (GS)- 2x25 kV AC
Traction Electrification and associated work**

- ST Stations
 - TU Tunnels
 - AL Alignment
 - RW Right - Of - Way
 - CE Civil Engineering (earth work, culverts, pedestrians, foot bridge, agricultural underpass, survey, track drainage, etc.)
 - RB Railway Bridges
 - RO Road Over Bridges
 - RU Road Under Bridges
 - EC Environmental Control System
 - UT Utilities (Power, Gas, Telecoms, Electric, Water supply, Sewer lines)
 - SE Structural Engineering (structural steel, reinforced concrete etc.)
 - GE Geotechnical Engineering (Instrumentation, ground treatment, de-watering, etc.)
 - AR Architecture
 - LS Landscape
 - EE Electrical Engineering (low voltage)
 - ME Mechanical Engineering (ventilation, fire fighting, plumbing)
 - PS Power Supply (high voltage, traction power)
 - SG Signalling (train control)
 - CM Telecommunications,
 - TK Track-work
 - TM Traffic Management (Roads, Pavements)
 - WS Water Supply
 - SW Switching Stations
 - GS Grid Sub-station
 - TS Traction Sub-station
 - TL Transmission Line
 - SC SCADA system
 - OL Overhead Line Equipment
- iv Section
- A Unique & digit Code for identifying Station from – to
Like PWL – SNP to define the section between Palwal to Sonapat
- v Location Code (3 / 4 digit)
- Unique Location code shall be essential to identify the location of Installation, station code/ TSS code/ OCC code

- vi A unique Three (3) digit number (from 001 to 999), identifying each drawing.
- vii A single letter (A to Z except I and O) denoting the sequence of revision to the drawing. The initial drawing issue will carry a revision letter "A".

Example: Drawing Title Block:

Status	Drawing No:	Revision:
P	4 / SC / PWL-SNP / SNL/235	B

(Note: The comparable computer reference is "4SC PWL-SNP -0235B")

Denotes:

(P) Traction System/SCADA/ Section between PWL-SNP / Location KHJ/Drawing' identifying Number 235, Revision B.

4. TYPES OF DRAWINGS

Types of Drawing such as 'Working drawings', Layout Drawings, Equipment Drawings, Shop Drawings, Reference Drawings and Manufacturing Drawings and As Built Drawings.

5. COMPUTER AIDED DESIGN AND DRAWING (CAD) STANDARDS

The main objectives of the CAD standards are as follows:

- a. To ensure that the CAD data files produced for project are coordinated and referenced in a consistent manner.
- b. To provide the information and procedures necessary for a CAD user from one discipline or external organization to access (and use as background reference), information from a CAD data file prepared by another discipline or external organization.
- c. To standardize the information contained within CAD data files which may be common to more than one discipline such as drawing borders, title boxes, grid lines etc.
- d. To establish procedures necessary for the management of CAD data files.
- e. To ensure all contractors use 'Model space' and 'Paper space' in the production of their CAD files.
- f. To facilitate co-ordination between contractors, all drawings issued by contractors for co-ordination or record purposes shall be produced using CAD methods.
- g. The intent of the issue of digital information is to aid the interface design by others.
- h. The definitive version of all Drawings shall always be the paper or polyester film copies which have been issued by the Contractor or organization originating the drawing and also held in the Project's electronic document control system.
- i. Drawings and drawing packages issued for co-ordination, record purposes or for acceptance shall be accompanied by a complete set of the corresponding CAD data files.
- j. Any contractor or organization making use of the CAD data from others shall be

responsible for satisfying him that such data is producing an accurate representation of the information on the corresponding paper drawing which is satisfactory for the purpose for which he is using it, provided the general principles of this section have been achieved by the originator of the CAD data, contractors making use of the CAD data from others shall not be entitled to require alterations in the manner in which such CAD data is being presented to them.

- k. In particular, automatic determination of physical dimensions from the data file shall always be verified against the figured dimensions on the paper or polyester drawings.
- l. Figured dimensions shall always be taken as correct where discrepancies occur.

6. TERMINOLOGY AND ASSOCIATED STANDARDS

Any terminology used within this section that is ambiguous to the user shall be clarified with the Engineer. Indian national and Indian Railways standards are to be used in principle as a guide for drawing practice, convention, CAD data structure and translation.

7. PAPER DRAWINGS

For the Project "Paper" drawings are considered to be the main vehicle for the receipt and transmittal of design and production information, typically plans, elevations and sections.

8. CAD QUALITY CONTROL

- a. Random CAD Quality control audits will be carried out by Engineer on all CAD media received and transmitted.
- b. These checks DO NOT verify the technical content of the CAD data received or transmitted (as this is the responsibility of the originating organization); however compliance with project CAD and Drawing Standards shall be checked.
- c. In addition, all contractors who transmit and receive CAD data from the Project shall have CAD quality control procedures in place.
- d. A typical quality control procedure shall contain CAD data quality checking routines coupled with standards for CAD data transmittal and archiving.

9. CAD DATA TRANSFER MEDIA AND FORMAT

When CAD data is received and transmitted between the Engineer and the Contractor, the media shall be as follows:

- a. All CD-R/RW and DVD+/-R must be labeled on the data shield with:
 - i. Name of Company
 - ii. Project Title
 - iii. Drawing Filenames
 - iv. Disk No. / Total No. of disks
- b. All media shall be submitted with a completed form (CAD Disk)
- c. The CAD transmittal format from contractors shall be in AutoCAD (version 2011)

or latest.

10. REVISIONS

All 'Revisions', 'In abeyance' and 'Deletions' shall be located on a common layer which can be turned on or off for plotting purposes.

11. BLOCK LIBRARIES, BLOCKS AND NAMES

- a. All Symbols produced as CAD Cells shall conform to Indian or International Standards.
- b. All blocks created shall be primitive (i.e. NOT complex) and shall be placed absolute (i.e. NOT relative).
- c. The Contractor's specific block libraries shall be transmitted to Engineer together with an associated block library list containing the filename (max. 6 characters) and block description.
- d. The Contractor shall ensure that the library is regularly updated and circulated to all other users, together with the associated library listing.
- e. All blocks of a common type, symbols or details should initially be created within a CAD "Model Space File" specifically utilized for that purpose. These files will be made available on request by Engineer.
- f. All blocks created will typically be 2D unless 3D is specifically requested. They shall have an origin at a logical point located within the extents of each block's masked area or volume.

12. CAD DIMENSIONING

- a. Automatic CAD Dimensioning will be used at all times.
- b. Any dimensional change must involve the necessary revision to the model space file.
- c. If the CAD Quality Control Checks find that the revisions have not been correctly carried out, the rejection of the entire CAD submission will result.

13. CAD LAYERING

- a. All CAD elements shall be placed on the layers allocated for each different discipline.
- b. The Contractor's layer naming convention shall be submitted for the Engineer's approval.

14. GLOBAL ORIGIN, LOCATION AND ORIENTATION ON THE ALIGNMENT DRAWINGS

- a. Location or plan information in "Model Space" files shall coincide with the correct location and orientation on the project grid for each specific contract.
- b. Location plans shall have at least three setting out points shown on each CAD "Model Space" file. Each setting out point shall be indicated by a simple cross-hair

together with related East and North co-ordinates.

- c. The Contractor shall establish the three setting out co-ordinates for their respective works which will then be used by the Contractor and the sub-contractor(s), if any.

15. LINE THICKNESS AND COLOUR

To assist plotting by other users, the following colour codes will be assigned to the following line thickness / pen sizes:

Colour	Code No.	Line Thickness
Red	10	0.18
White	7	0.25
Yellow	2	0.35
Brown	34	0.5
Blue	130	0.7
Orange	30	1.0
Green	3	1.4
Grey	253	2.0

16. CAD UTILIZATION OF 2D AND 3D FILES

Although the project standard is 2D CAD files, certain disciplines and contractors may use 3D CAD files for specific applications or where the isolated use of 3D aids the design and visualization process (i.e. architecture, survey and utilities).

(End of Appendix-2)

APPENDIX-3: DESIGN CERTIFICATE

The Contractor shall submit the Design Certificate with all Design Documents and Drawing. All the Drawings shall be printed with Design certificate signed and issued by Project Manager of Contractor.

DESIGN CERTIFICATE

This Design Certificate refers to Submission No..... which comprises:

[*Design Package No. / the Detailed Design and Drawing Submission No. / Technical Submission No] in respect of:

[description of the Works to which the submission refers]

The contents of this submission are scheduled in Section A below.

The documents scheduled in Section B below, for which a Notice of No Objection has been issued, are of relevance to this submission.

DESIGNER'S STATEMENT

We hereby certify that:

- a) The design of the Works, as illustrated and described in the documents scheduled in Section A below, complies with the specifications requirements and. [see note 1 below];
- b) The outline designs, design briefs and performance specifications of those elements of the Works as illustrated and described in the documents scheduled in Section A below comply with the specifications requirements and. [see note 1 below];
- c) The design of the Works, as illustrated and described in the documents scheduled in Section A below, complies with the Employer's Requirements specifications requirements and.....
[see note 1 below] except in the following respects:
 - (i)(to be completed by Contractor/Designer)
 - (ii) (etc.)
- d) An in-house check has been undertaken and completed to confirm the completeness, adequacy and validity of the design of the Works as illustrated and described in the documents scheduled in Section A below;
- e) All necessary and required approvals relating to the design of the Works, as illustrated and described in the documents scheduled in Section A below, have been obtained and copies of such approvals are annexed in Section C below;
AND (in the case of a submission covering a part of the Works only):
- f) All effects of the design comprising the submission on the design of adjacent or other parts of the Works have been fully taken into account in the design of those parts.

Signed by 'Authorized Representative'
(for Designer)
Name
Position/ Designation
Date

CONTRACTOR'S CERTIFICATION

This is to certify that all design has been performed utilizing the skill and care to be expected of a professionally qualified, competent designer, experienced in work of similar nature and scope. This further certifies that all works relating to the preparation, review, checking and certification of design has been verified by us.

Signed by 'Authorized Representative' (for Contractor)

Name

Position/Designation

Date

Note 1

The Contractor shall insert one of the following, as applicable:

- (i) The Contractor's Technical Proposals
- (ii) The Contractor's Technical Proposals and Design Packages Nos.....for which a Notice of No Objection has been issued.
- (iii) Design Packages Nos..... for which a Notice of No Objection has been issued if such Design Packages develop and amplify the Contractor's Technical Proposals.
- (iv) The Detailed Design

Section A

Submission no. comprises the following :

Drawings : *(Title, drawing number and revision)*

Documents: *(Title, reference number and revision)*

Others:

Section B

Documents for which a Notice of No Objection has been issued and which are of relevance to this Submission No.

Document:

Submitted with

[* Design Package No...../

Detailed Design Submission No...../

Good for Construction Drawing Submission No./

Technical Submission No./

Date of Issue of Notice of No Objection

(* Delete as appropriate)

*The Contractor is required to provide
this information in respect of each
document in Section B*

The Contractor is required to provide this information in respect of each document in Section B

Section C

[Contractor to attach copies of necessary and required approvals]

(End of Appendix-3)

APPENDIX-4: TEMPORARY WORKS

1. SCOPE

- (1) All necessary Temporary Works required for the realization of the works such as Temporary Facilities and Temporary Utility Services including labour camps shall be provided & maintained by the Contractor for his own use, for his sub-contractors, the Engineer & the Employer unless otherwise authorized by the Engineer. The standard conditions applying to Temporary Power Supply to any Works Area by the Contractor for its Site facilities are detailed but not limited to, as under. To facilitate Permanent works The contractor would be required to establish temporary Installation may include but not limited to:
 - a. Site office, Ware house , Material stock area, fencing of site,
 - b. Lighting, water and power distribution, cabling and earthing at site
 - c. Construction Equipment supply , mobilization and installations
 - d. Labour camp
 - e. chartered/ unchartered utility Diversions
- (2) The Contractor shall take adequate precautions in the provision & the maintenance of the Temporary Power Supply to Temporary Works and to Works areas. To establish temporary Utility power, the work should be carried by the skilled electrician under the supervision of qualified engineer and the site shall be monitored by the qualified engineer to ensure electrical safety at site.

2. GENERAL

- (1) The Contractor shall nominate a qualified electrical supervisor whose name and qualifications shall be submitted in writing to the Engineer for review, who shall be solely responsible for ensuring the safety of all temporary electrical equipment on Site.
- (2) The Contractor shall not install or operate any temporary electrical systems on the Site until this electrical engineer is appointed and has commenced duty.
- (3) The name and contact telephone number of the qualified electrical engineer shall be displayed at the main distribution board for the temporary electrical supply so that he can be contacted in case of an emergency.
- (4) The Contractor shall submit details of all base electrical circuits, characteristics and the equipment for all temporary electrical installations together with details of the temporary electrical equipment(s) to the Engineer for his consent,
- (5) Temporary electrical Site installations and distribution systems shall be in accordance with the rules and regulation applicable for and/or applied by:
 - a. The local electrical company supply rules;
 - b. Wiring regulations;
 - c. Distribution of electricity on construction and building sites;
 - d. Distribution assemblies for electricity supplies for construction and building sites;

- e. Regulations for fire safety norms and requirements for civil works; and
- f. Any other applicable Indian standards and regulations.

2.1 Material, Appliances and Components

All material, appliances and components used within the distribution system shall comply with Indian standards.

2.2 Design Considerations

- (1) Distribution equipment utilized within the temporary electrical distribution system shall incorporate the following features:
 - a. Flexibility in application for repeated use;
 - b. Suitability for transport and storage;
 - c. Robust construction to resist moisture and damage; and
 - d. Safety in use.
- (2) All cabling shall be run at high level wherever possible and be firmly secured to ensure it does not present a hazard or obstruction to people and equipment.

2.3 Mains Voltage

"SHE Manual" of HRIDC provided in "Reference Documents – Part 2, Section VII-4 of Bidding Documents" stipulates certain voltages for different works. In case of conflict of provisions regarding voltage under this Appendix, those specified in the SHE Manual shall prevail.

- (1) The Site mains voltage shall be 400V/ 3 phases 4-wire system 50 Hz.
 - a. Single phase voltage shall be 230V supply.
 - b. Reduced voltages shall conform to Indian Standards.
- (2) The following voltages shall be adopted for typical applications throughout the distribution systems:
 - a. Fixed plant – 400V/ 3 phase;
 - b. Movable plant fed by trailing cable – 400V /3 phase;
 - c. Installations in Site buildings - 230V/240V /1 phase;
 - d. Fixed flood lighting - 230V/240V 1 phase;
 - e. Portable and hand held tools – 12V, 24V or 36V /1 phase;
 - f. Site lighting (other than flood lighting) – 12V, 24V or 36V /1 phase; and
 - g. Portable hand-lamps (general use) – 12V, 24V or 36V /1 phase.
- (3) Protection of Circuits
 - a. Protection shall be provided for all main and sub-circuits against excess current, under and over voltage, residual current and earth faults.
 - b. The protective devices shall be capable of interrupting (without damage to any equipment or the mains or sub-circuits) any short circuit current that may occur.
 - c. Discrimination between circuit breakers, circuit breakers and fuses shall be in accordance with the Indian Standards.

2.4 Earthing

- (1) Earthing and bonding shall be provided for all electrical installations and equipment to prevent the possibility of dangerous voltage rises and to ensure that faults are rapidly cleared by installed circuit protection.
- (2) Earthing systems shall conform to the following standards:
 - a. Wiring regulations;
 - b. Guide for safety in AC substation grounding.
 - c. Indian Electricity Rules

2.5 Plugs, Socket Outlets and Couplers

Low voltage plugs, sockets and couplers, as well as the high voltage couplers and 'T' connections shall be colour coded in accordance with, and conform to Indian Standards. All the Plugs and sockets used at construction site shall be IP 65 protected with Residual Current Circuit Breaker RCCB/ Earth Leakage Circuit Breakers (ELCB) to prevent Leakage of current and electrocution in Compliance to Indian Electricity Rule.

2.6 Cables Used for Temporary Works

- (1) Cables shall be selected after full consideration of the conditions to which they will be exposed and the duties for which they are required.
- (2) Temporary Supply cables shall be minimum 3-core (P + N + distinctly colored PE) for single phase power distribution and in accordance with Indian Standards with TNS Earthing. Similarly, the cable used for 3-phase power distribution shall also conform the TNS earthing system. Earthing/ armoured wire shall be retained at zero potential. All the cables used at site will be joint-less. Joints if any shall be made through proper Jointing Kit in IP 65 enclosure to prevent accidental touch and electrocution of the staff/ public. All the cables laid underground at worksite shall be armoured. All the cables shall conform BIS and have Marking conforming to standards. No cable with damaged insulation shall be used and the cable damaged if any shall be removed immediately and ensured by the Project Manager.
- (3) For supplies to mobile or transportable equipment where operation of the equipment subjects the cable to flexing, the cable shall conform to Indian Standards as well as one of the following specifications appropriate to the duties imposed on it:
 - a. Flexible cables for use at mines and quarries;
 - b. Rubber insulated cables for electric power and lighting; and
 - c. Insulated flexible cords and cables.
- (4) All cables which have a voltage to earth exceeding 65V (except for supplies from welding transformers to welding electrodes) shall be metal sheathed and/or armoured which shall be continuous and effectively earthed. In the case of flexible or trailing cables, such earthed metal sheath and/or armour shall be in addition to the earth core in the cable and shall not be used as the sole earth conductor.
- (5) Armoured cables having an over-sheath of polyvinyl chloride (PVC) or oil resisting and flame retardant compound shall be used whenever there is a risk of mechanical damage occurring.

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- (6) Cables with an applied voltage to earth exceeding 12V but not normally exceeding 65V, shall be insulated and sheathed with a general purpose or heat resisting elastomer.
- (7) The Welding earthing cable shall be insulated and conform to relevant standards. Other than the insulated Cables shall not be used at work site to avoid any leakage and electrocution at worksite.

2.7 Lighting Installation

- (1) Where Site works are required during the night, the lighting circuits shall be run separate from other sub-circuits and shall be in accordance with Indian Standards. Contractor shall submit method statement for "work during night" for review by the Engineer.
- (2) Voltage shall not exceed 55V to earth except when the supply is to a fixed point and where the lighting fixture is fixed in position.
- (3) Luminaries shall have a degree of protection not less than IP 54.
- (4) In particularly onerous environments where the luminaries are exposed to excesses of dust and water, a degree of protection to IP 65 shall be employed.
- (5) The Contractor shall provide a minimum lighting level of 200 lux by localised lighting in all areas where required for carrying out the works.
- (6) Wherever a risk of damage may occur, luminaries shall be mechanically protected against impact damage by use of wire guards or other such devices.

2.8 Electric Motors

- (1) Totally enclosed fan cooled motors to Indian Standards shall be used.
- (2) Motor control and protection circuits shall be as stipulated in Indian Standards.
- (3) Emergency stop switches shall be provided for all machinery.

2.9 Inspection and Testing

Electrical installations on Site shall be inspected and tested in accordance with the requirements of the wiring regulations.

2.10 Maintenance

- (1) Regular maintenance and checking of control apparatus and wiring distribution systems shall be carried out by an engineer or electrician (duly qualified to carry out the said checks) to ensure safe and efficient operation of the systems.
- (2) All portable electrical appliances shall be permanently numbered (scarf tag labels or similar) and a record kept of the date of issue, date of the last inspection and the recommended inspection period.

2.11 Metering

The Contractor shall install and register a separate energy meter for each supply of electricity from the applicable suppliers. The Contractor shall pay all required charges for the supplied electric energy.

(End of Appendix-4)

APPENDIX-5: REQUIREMENT FOR CONSTRUCTION

1. THE SITE

1.1 The Site details and locations are defined in the Particular Specifications and in Section VII-3: Drawings and Reference Document of the Bid Document.

1.2 Use of the Site and Work Areas

1.2.1 The Site or Contractor's Temporary Facilities including Contractor's equipment shall not be used by the Contractor for any purpose other than for carrying out the Permanent or Temporary Works or Contractor's Temporary Facilities except that with the consent of the Engineer in writing.

1.2.2 The Employer shall hand over the Site to the Contractor free of encumbrances as per the agreed schedule. Once the Site is handed over to the Contractor, its integrity, safety and security etc. shall be the responsibility of the Contractor until the issue of Taking Over Certificate unless otherwise directed by the Engineer.

1.2.3 The location and area of material stacking and each stockpile of material including excavated material within the ROW shall be subject to approval by the Engineer. Stockpiles of material and stacking of steel etc. shall be maintained at all times in a stable condition.

1.2.4 In case spare land is available with the Employer the same can be handed over to the Contractor free of cost for the purpose of establishing temporary construction depot(s). However, whenever Employer requires this portion of land back, the same shall be handed over to the Employer with a month's notice at no extra cost / compensation to the Contractor.

1.3 Access to the Site

1.3.1 The Contractor shall make its own arrangements, at their own cost for access required to the Site of TSS, SP and SSP.

1.3.2 The existing access roads, if used by the Contractor for transport of his men, material and equipment shall be maintained by the Contractor to a satisfactory level to allow uninterrupted flow of traffic including the public traffic otherwise using these roads including cleanliness.

1.3.3 In addition, the Contractor shall ensure that access to every portion of the Site is continuously available to the Employer's Personnel and the Engineer and other entities authorized by the Employer / Engineer.

1.4 Access / Egress through Work Areas

The Contractor shall be responsible for ensuring that any access or egress through the Work Areas boundaries are controlled so that no disturbance to residents or damage to public or private property occur as a result of the use of such access or egress by his employees and Sub-Contractors.

1.5 Survey of the Work Areas

In addition to the validation of the data provided by the Employer and additional survey, as considered necessary by the Contractor, the Contractor shall carry out survey to identify any encumbrance infringing the Permanent Works and shall advise the Engineer accordingly. The survey shall be carried out before the site clearance, wherever possible and in any case prior to the commencement of the Work in any Work Areas. The survey shall be carried out by the Contractor and agreed with the Engineer.

1.6 Temporary Fencing and Signboards

- 1.6.1 The Contractor shall erect hoardings, temporary fences and/or gates around the Work Areas specifically near the populated areas to prevent entry by unauthorized persons to his Work Areas as long as they are deemed to be necessary. The Contractor shall issue, all his personnel including the personnel working with sub-contractor(s), identity cards for entering the Work Areas. Necessary arrangements to ensure that no unauthorized person enters the Work Areas and shall be made by the Contractor by way of posting of security guards. Use of hoardings / temporary fencing / signboards etc. shall not be permitted for any kind of advertisement / publicity etc., without the consent of the Engineer.
- 1.6.2 For executing the work adjacent to running traffic areas, the Contractor shall erect fences and gates around its areas of operations to prevent accidents as well as post competent flagmen/ guards. The Contractor shall submit proposals for the fencing of the Work Areas to the Engineer for review. No Work shall be commenced in any Works Area until the Engineer has been satisfied that the fencing installed by the Contractor is sufficient to prevent any unauthorized entry.
- 1.6.3 Project signboards shall be erected at the Site 7 days prior to the commencement of the construction activities of the relevant Work Area. The type, size and locations of project signboards shall be agreed by the Engineer before manufacture and erection of the signboards.
- 1.6.4 The consent of the Engineer shall be obtained before hoarding, fences, gates or signs are removed. Hoardings, fences, gates and signs which are to be left in positions after the issue of Taking-Over Certificate shall be repaired and repainted as instructed by the Engineer.
- 1.6.5 Hoarding/fencing can be reused after removing from one place to other locations / sites provided they are in good condition and consented by the Engineer.
- 1.6.6 Damage/worn-out fencing/hoarding shall be replaced by the Contractor within 24 hours. Engineer's decision regarding need for replacement shall be final and binding and if no action is taken by Contractor, the same shall be got done by the Engineer and cost of any repair shall be deducted by the Engineer from any payment due to the Contractor.
- 1.6.7 The types, sizes and locations of project signboards shall be agreed with the Engineer before manufacture and erection. Other advertising signs shall not be erected on the Site.
- 1.6.8 Hoardings, fences, gates and signs shall be maintained in good order by the Contractor until the completion of the Works, whether such hoardings, fences, gates and signs have been installed by the Contractor or by others and transferred to the Contractor during the period of the Works.
- 1.6.9 All hoardings, fences, gates and signs installed by the Contractor shall be lit during night or low visibility as required and advised by the Engineer and removed by the Contractor upon the completion of the Works, unless otherwise directed by the Engineer.

1.7 Clearance of the Site

All Temporary Works shall be removed by the Contractor upon issue of the Taking Over Certificate except the Temporary Facilities with necessary utility services, required for completing his obligations after the issue of Taking-Over Certificate unless otherwise directed by the Engineer. The Contractor shall dismantle and remove all Temporary Works and the land in which the Temporary Works have been located, shall be properly treated, to complete the Works as shown in the Construction Drawings.

2. CONSTRUCTION-PRECAUTIONS

2.1 Precautions While Working In Close Proximity of Existing Indian Railway/DFCCIL Track

a. General

- i Prior to the commencement of construction operations, the Contractor shall obtain all necessary clearance(s) from the concerned authorities.
- ii Any construction activity involving the existing embankment/formation/running track of the Indian Railways shall be carried out only with the prior specific authorization of the Engineer.

b. Works being executed outside running lines are further divided into following 3 sub-groups depending upon their distance from the IR track:-

- i Works being done within 3.5 meters from center of track.
- ii Works being done between 3.5 meters and 6 meters from center of track
- iii Works being done beyond 6 meters from center of track

If a work site is located far away from the existing track but the vehicles in connection with the work are required to ply within the distance from center of track as mentioned above, it will be construed that the work is being executed under above classification.

c. Works being done within 3.5 meters from center of track

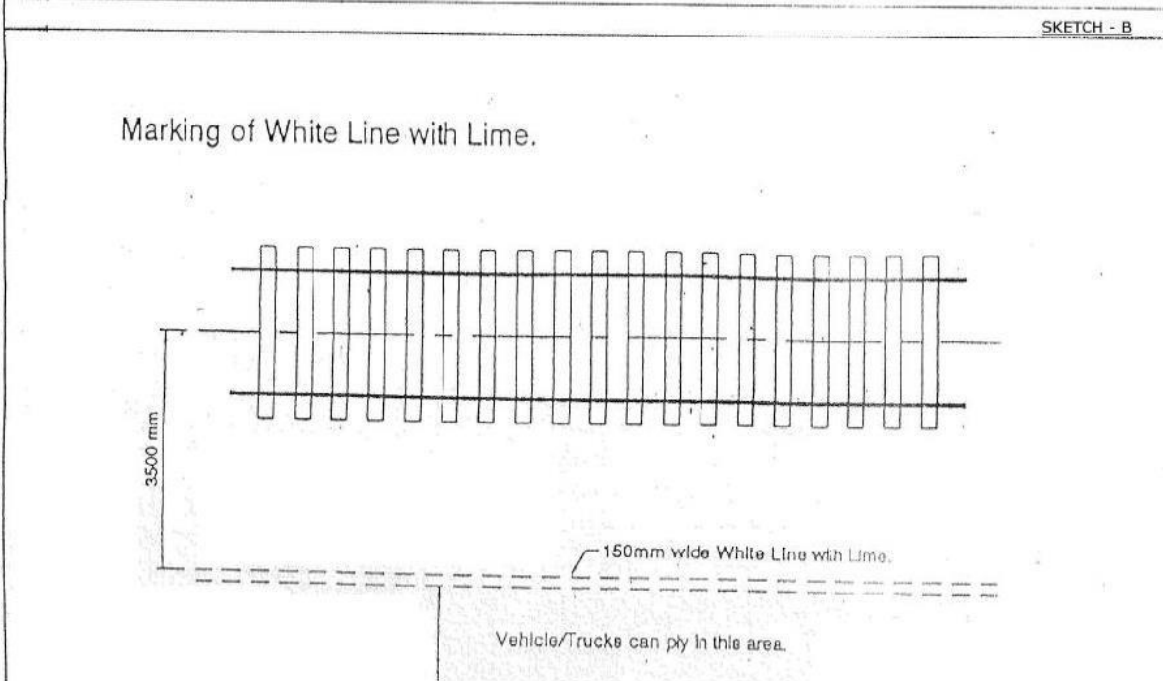
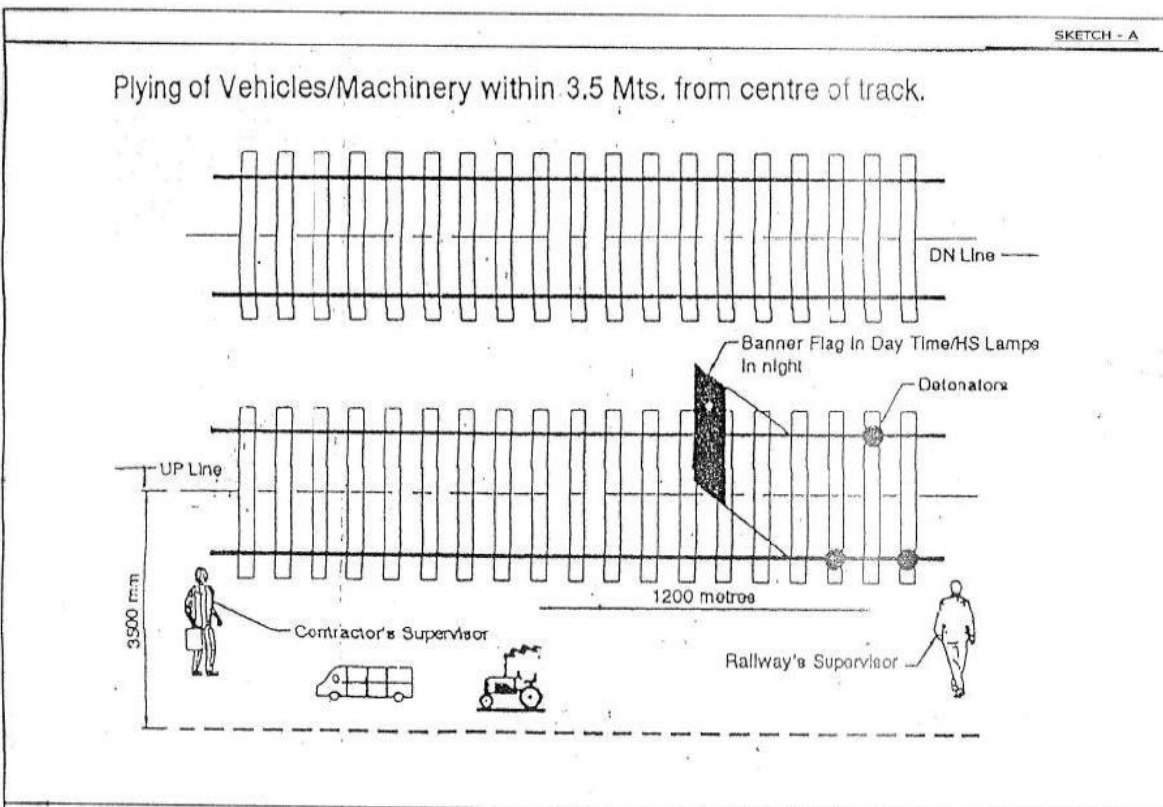
All works planned within 3.5 meters from center of running line or which involve working of machineries and vehicles within this zone, are to be done essentially under block protection and necessary safety precautions for protection of track as per para 806 and 807 of IRPWM shall be taken. This includes even occasional plying of vehicles/ machineries for short durations.

d. Works being done between 3.5 meters and 6 meters from center of track

Following precautions shall be taken when works are required to be done between 3.5 meters to 6 meters from track center or machines/vehicles are required to work/ply within this zone.

- i Before start of work, demarcation should be done parallel to running track at a distance of 3.5 meters from center of track in advance, as per sketch B, by 150 mm wide white line of lime. Any work or movement of machinery infringing this line will need block protection. Barricading should be put up at such locations, as per sketch C, to ensure that even by carelessness or oversight, vehicles do not infringe fixed dimensions. Barricading design shall be approved by the Engineer.
- ii In case vehicles have to ply or machineries have to work within this zone, Railway's and contractor's supervisors be positioned as shown in sketch D except mentioned in para (iii) below:

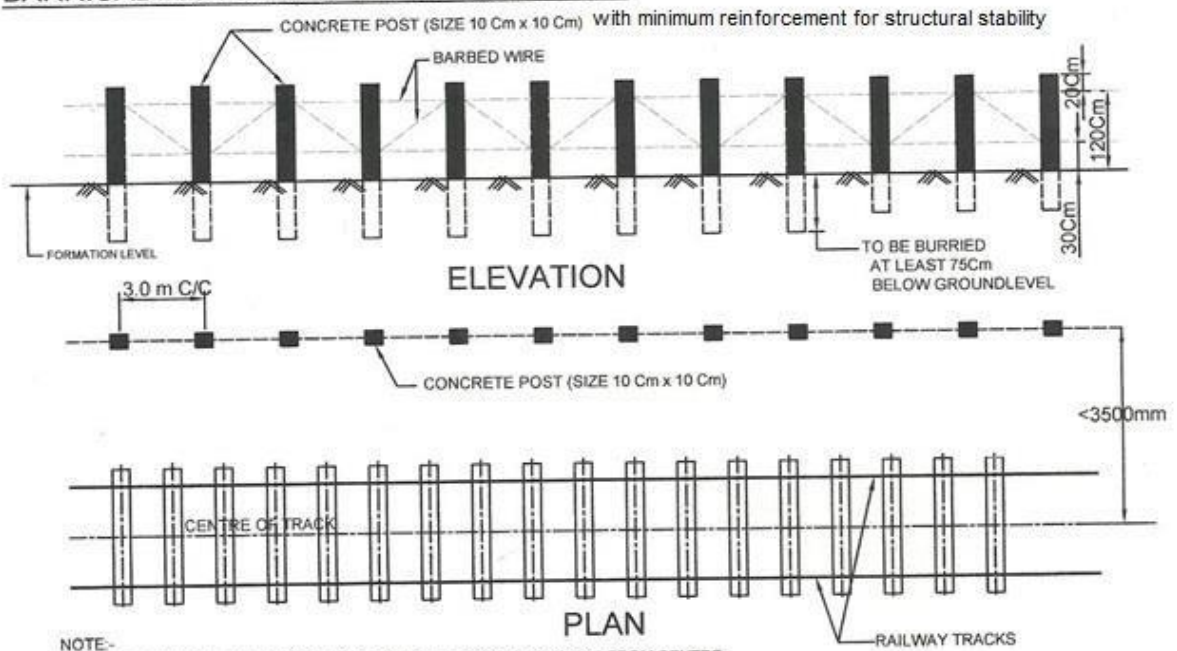
SAFTY/PROTECTION ARRANGEMENT SKETCHES



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SKETCH - C

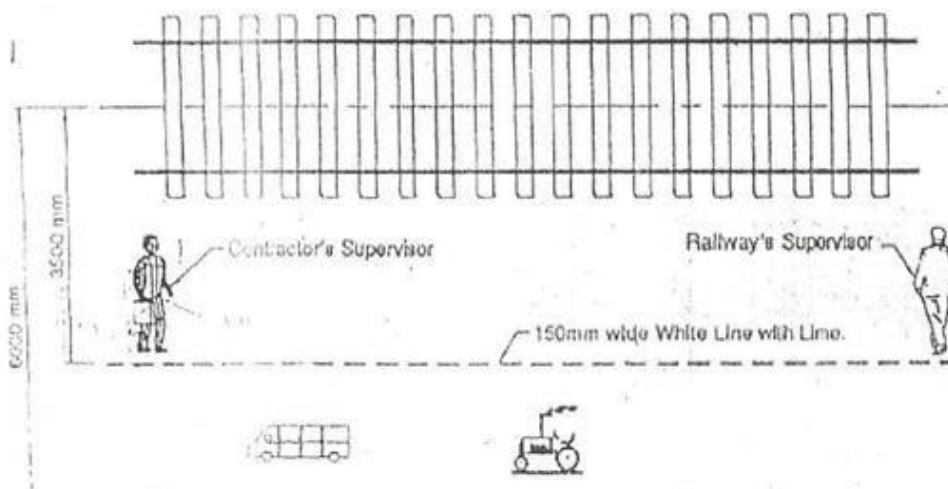
BARRICADING FOR SAFETY AT WORK SITE



NOTE-
 BARRICADING OF WORK SITES SHOULD BE PROVIDED AS FAR FROM CENTRE LINE OF TRACK AS POSSIBLE BUT NOT LESS THAN 3.5m FROM CENTRE LINE OF TRACK WHEN THE BARRICADING IS PROVIDED PARALLEL TO TRACK OF >3.5m FROM CENTRE LINE. BARRICADING PERPENDICULAR TO THE TRACK ALSO NEED TO BE PROVIDED AT TERMINATING ENDS UPTO 3.5M FROM CENTRE LINE OF TRACK TO AVOID MOVEMENT OF ANY ROAD VEHICLE BETWEEN BARRICADING AND THE TRACK.

SKETCH - D

Plying of Vehicles/Machinery between 3.5 Mts. to 6.0 Mts. from centre of track.



- iii. Instead of a Railway supervisor it would be a responsible and trained staff of the Contractor as mentioned in para 2.1. d), ii above.
- iv. Additional trained staff of the Contractor, as mentioned in para 2.1. d), ii above, shall be posted where turning of vehicles is required during working. Location for reversing vehicles should be nominated and it should be

selected in such a way that there is no danger to running trains at such a location. Such trained staff of the Contractor should be available with hand flag(s) so that vehicles do not come closer to track by 3.5 meters. Wherever vehicles have to take turn, it should be done in such a way that the driver is invariably facing the running track at all times.

- v. Look out men should be posted along the track at a distance of 800 meters from location of work with red flag and to whistle in face of road vehicles and approaching trains. Look out men shall also be suitably trained staff of Contractor as mentioned in para 2.1.d), ii above.
 - vi. In addition to look out men, caution order needs to be issued to trains and speed restrictions imposed wherever considered necessary through Employer.
 - vii. Arrangements should be made to protect the track in case of emergency at work site.
 - viii. All temporary arrangements required during execution should be done in a manner that moving dimension is not infringed.
 - ix. Individual vehicle/machinery shall not be left unattended at site of work. If it is unavoidable and essential to stable it near running track, it shall be properly secured and manned even during non-working hours with all arrangements to protect the track from infringement.
 - x. Any material unloaded or shifted along the track should be kept clear of moving dimensions and stacked at a specified distance from running track.
 - xi. Movement of vehicle/working of machineries should be prohibited at night. However, in case of emergency when night working is unavoidable, adequate lighting shall be provided with all protection measures as mentioned above in full force. All night working near IR track shall require Engineer's prior approval.
 - xii. The work site should be suitably demarcated to keep public and passengers away. Necessary signage, boards, such as "work in progress" etc. should be provided at appropriate location to warn public/passengers.
 - xiii. Contractor's drivers/operators handling vehicles/machineries shall be issued a fitness certificate by the safety officer of the Contractor after educating them about safety norms and after taking assurance in writing for working within vicinity of railway's track.
 - xiv. While working on cuttings with machineries or when there is movement of vehicles above cutting, if there is possibility of any of the following circumstances, work has to be done under block protection:
 - Any possibility exists for machinery/vehicle after toppling/due to loss of control come over track or infringe it.
 - Chance of machineries/vehicles to come within 3.5 meters from track center though working beyond it.
- e. Works being done beyond 6 meters from center of IR/DFCCIL track.**
- No precautions are needed except in cuttings or where the work can affect train running in any way.

3. CARE OF THE WORKS

3.1 General

- a. Unless otherwise permitted by the Engineer, all works shall be carried out in dry conditions.
- b. The Works, including material for use in the Works, shall be protected from damage due to water. Water on the Site and water entering the Site shall be promptly removed by temporary drainage or pumping system or by other methods capable of keeping the Works free of water.
- c. The discharge points of the temporary drainage / pumping systems shall be as per the consent of the Engineer and shall meet all the requirements as described in Section VII-4: *ESHS Manual, Part 2, Employer's Requirements*.
- d. The methods to be used for keeping the Works free of water shall be carefully chosen so that any settlement of or damage to the Works and / or adjacent existing structures should not occur.

3.2 Protection of the Works from Weather

- a. Works shall not be carried out in weather conditions that may adversely affect the Works unless proper protection is provided to the satisfaction of the Engineer.
- b. Permanent Works including material for such works, shall be protected from exposures of weather conditions that may adversely affect such Permanent Works or material.
- c. During construction of the Works, storm restraint systems shall be provided where appropriate. These systems shall ensure the security of the partially completed and ongoing stages of construction in all weather conditions. Such storm restraint systems shall be installed as soon as practicable and shall be compatible with the site conditions.
- d. The Contractor shall at all times, program and carry out the Works duly ensuring protective arrangements such that the Works can be made safe in the event of storms.

3.3 Protection of the Finished Works

The finished Works shall be protected from theft, pilferage or any damage that could arise due to any reason. If required, sections of route may be antitheft charged at 2.2kV but only on following a strict protocol as laid down in relevant portion of ACTM and as modified for use on HORC by the Employer and after having completed all steps laid down and after Engineer's approval.

4. HANDLING OF CHARTERED / UNCHARTERED PUBLIC UTILITY

- 4.1.1 All chartered/ unchartered utilities including the power lines 33 kV and below with in Right Of Way (ROW) of construction/ installation shall be removed and relocated by HRIDC. The relocation/ modification of utilities pertaining to traction and transmission lines crossings above 33 kV will also be dealt by HRIDC itself.
- 4.1.2 In case the Engineer decides the work of removal of any unchartered utility to be done by the Contractor, this shall be treated as a Variation to the Contract and shall be dealt as per the provisions for dealing with Variations in Contract. Contractor shall be paid as per actual work done for removal of uncharted utilities based on the Variation

approved by the Engineer, on case to case basis.

- 4.1.3 Any other public utility which interferes the Works and is required to be relocated and/or diverted and which the Contractor interprets as is not inclusive in the Contract, the Contractor shall notify the Engineer of the details of the public utility. The Employer may decide to relocate such utilities either on their own or through any other agency including the Contractor (SYS-1).

4.2 Other Interference

4.2.1 Alternative Access

Alternative access shall be availed / organized by the Contractor at his own cost through all public or private premises, when interference with the existing access occurs, to enable the Works to be carried out. The arrangements for the alternative access shall be as agreed by the Engineer and the concerned agencies. The permanent access shall be reinstated as soon as practicable after the Works are complete and the alternative access shall be removed and reinstated immediately as soon as it is no longer required. Proper signage and guidance shall be provided for the traffic / users regarding diversions.

4.2.2 Trees

Material, including excavated material, shall not be banked around trees. Trees shall be protected from damages at all times by the method(s) consented to by the Engineer. Unless otherwise consented to by the Engineer, trees shall not be trimmed or cut as stated in Section VII-4: *ESHS Manual, Part 2, Employer's Requirements*. However, the contractor shall be required to prune the tree leaves coming in proximity of the energized OHE as per the Indian Railways Guidelines before taking over of the OHE assets by the Employer.

4.2.3 Removal of Trees, Graves and other Obstructions

Trees within ROW shall be cut by CST Contractor. If any tree, grave and other obstruction is required to be removed in order to execute the Works and such removal has not already been arranged for, the Contractor shall draw the Engineer's attention to them in good time to make necessary arrangement for such removal. The Contractor shall not itself remove them unless the Engineer has given consent.

4.2.4 Protection of the Adjacent Structures and Works

The Contractor shall take all necessary precautions to protect the structures or works being carried out by others adjacent to and, for the time being, within the Site from the effects of vibrations, undermining and any other earth movements or the diversion of water flow arising from its work.

4.3 Use Of Roads

4.3.1 General

- a. Measures shall be taken to prevent the excavated material, silt or debris from entering gullies on roads and footpaths, entry of water to gullies shall not be obstructed.
- b. All surfaced roads (public / private) which are chosen for construction activities in the Traffic Management Plan, shall not be used by the Contractor's tracked vehicles unless protection against damage is provided by the Contractor and / or appropriate remedial measures are prepared and agreed with the concerned parties.

4.3.2 Traffic Management Plan

The Contractor shall develop a detailed Traffic Management Plan for the Works under the Contract. The purpose is to develop a Traffic Management Plan to cope with the traffic disruption as a result of construction activities by identifying strategies for traffic management on the roads and neighborhoods impacted by the construction activities. The Contractor shall implement the Traffic Management Plan throughout the whole period of the Contract. The basis for the Plan shall take into consideration four principles:

- a. to minimize the inconvenience of road users and the interruption to surface traffic through the area impacted by the construction activities;
- b. to ensure the safety of road users in the impacted area;
- c. to facilitate access to the Work Area, and to maintain scheduled construction progress.
- d. to ensure traffic safety at each Work Area.

Wherever applicable, the Contractor shall obtain necessary approval from the transport authorities and police department for temporary traffic arrangement and control on public roads.

4.4 Reinstatement Of Public Roads And Foot Paths

- a. Temporary diversions, pedestrian access and lighting, signage, guarding and traffic control equipment, if any, shall be removed immediately when these are no longer required for the construction activities.
- b. Roads, footpaths and other items affected by temporary traffic arrangements and control shall be reinstated to the same condition as existed before the work started or as consented by the Engineer immediately after the relevant work is complete or at other times permitted by the Engineer.
- c. Wherever required, the Contractor shall submit his plan for reinstatement to relevant authorities and obtain their prior approval to carry out the work

4.5 Security

4.5.1 The Contractor shall be responsible for the security of the Site for the full time till the issue of Taking Over Certificate except for specific cases of railway envelope after it is handed over to the Employer and / or as directed by the Engineer. The Contractor shall set up and operate a system whereby only those persons entitled to be involved in the construction activities in the Contract could enter the Work Areas. For the Site located near the populated areas, the Contractor shall, with the consent of Engineer provide the specific points only at which entry through the security fence can be effected and shall provide gate(s) and barrier(s) at such point(s) of entry and maintain security guard throughout twenty four (24) hours duration all the day. The Contractor shall also arrange for such other security personnel and patrols elsewhere as may be necessary to maintain security.

4.5.2 The Contractor shall maintain all site boundary fences, wherever provided, in good condition and shall so arrange site boundary fences and security measures that the drainage arrangement is not affected. Notices shall be displayed at intervals around the Work Areas to warn the public of the dangers of entering the Work Areas

4.5.3 During the progress of the Works, the Contractor shall maintain such additional security patrols over the Works Areas as may be necessary to protect his own and his sub-contractor's facilities and equipment as well as the Works. In addition, the Contractor shall coordinate and plan the security of both the Works under the Contract and works of the

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other contractors including Interfacing Parties requiring access to the Site.

- 4.5.4 In order to operate such a security system, it will be necessary to institute the issue of unique passes to personnel and vehicles entitled to be on the Work Areas and a system of separately identifiable according to the shifts being worked on the Work Areas. The Contractor shall, at the outset, determine together with the Engineer, a system including the design of passes to suit the requirements of the foregoing and to suit the methods of activities to be adopted by the Contractor for these purposes. The Contractor shall, at all times, ensure that the Engineer has an up to date list of all persons entitled to be on each Work Area at any time. The Contractor shall also introduce a system for issue of passes to any outsider or person/vehicles belonging to agencies other than Employer/Engineer who may have to visit each of the Work Areas in connection with the Works.
- 4.5.5 The Contractor shall liaise with the other contractor(s) and the Interfacing Parties responsible for security of the adjacent areas and ensures that coordinated security procedures are operated, in particular in respect of vehicles permitted to pass through the Site and/or the adjacent sites. The security of the erected Conductors of the OHE as an antitheft charging with 2.2 kV supply shall be carried out in full liaison with other contractors.
- 4.5.6 Security and checking arrangements, as considered necessary shall be provided.

4.6 Contractor's Labour Camp

4.6.1 General

The Contractor shall comply with all requirements as detailed in Section VII-4: *ESHS Manual, Part 2, Employer's Requirements*.

4.6.2 Provision of Labour Camp

- a. The Contractor shall, at his own expense, make adequate arrangements for the housing, supply of drinking water and provision of bathrooms, latrines and urinals, with adequate water supply for his staff and workmen at the location authorized by Engineer.
- b. No labour camp shall be allowed at Site without the consent of the Engineer / Employer or any unauthorized place. The Contractor shall prepare a detailed labour camp plan to obtain the consent from the Engineer's.
- c. The Contractor, at his own cost, shall maintain all camp sites clean and sanitized.
- d. The Contractor shall obey all health and sanitary rules and regulations and carry out at his cost, all health and sanitary measures that may from time to time be prescribed by the Local/Medical Authorities and permit inspection of all health and sanitary arrangements at all times by the Engineer and the staff of the local municipality or other authorities concerned.
- e. Should the Contractor fail to provide adequate health and sanitary arrangements, these shall be provided by the Employer and the cost thereof recovered from the Contractor.
- f. The Contractor shall at his own cost, provide First Aid Stations as described in *Section VII-4, ESHS Manual, Part 2- Employer's Requirements*.
- g. The Contractor shall at his own cost, provide the following minimum requirements for fire precautions at suitable locations complying with the requirements of applicable Codes:

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- i. Portable Fire Extinguishers.
- ii. Manual Fire Alarms.
- iii. Water Supply for use by the Fire Service personnel.
- h. The Contractor shall at his own cost provide necessary arrangements for keeping the camp area sufficiently lighted to avoid accidents to the workers.
- i. The Contractor shall ensure that electrical installations are done by qualified electricians and as per the applicable Codes & Standards and these installations shall be maintained and daily maintenance records shall be available for inspection of the Engineer on demand.
- j. The sites should be secured by fencing and proper lighting.
- k. The construction contractor may ensure that all construction equipment and vehicle machinery may be stored at a separate place / yard.
- l. Fuel storage and refilling areas may be located 500 m away from the water bodies and from other cross drainage structures.
- m. All the construction workers should be provided with proper training to handle potential occupation hazards and on safety and health which include the following:-
 - (i) Environmental awareness program
 - (ii) Medical surveillance
 - (iii) Engineering controls, work practices and protective equipment
 - (iv) Handling of raw and processed material
 - (v) Emergency response
- n. Construction / labour camps shall be located away from forest areas, settlements, cultural heritage and historical sites and water bodies and dry river beds.
- o. It should be ensured by the construction contractor that the camp area is cleared of the debris and other wastes after the completion of construction. On completion of construction, the land should be restored back to its original form to the satisfaction of the Employer.

4.7 Camp Discipline

- a. The Contractor shall take requisite precautions and use his best endeavors to prevent any riotous or unlawful behavior by or amongst his workmen and others, employed directly or through sub-contractors.
- b. These precautions shall be for the preservation of the peace and protection of the inhabitants and security property in the neighborhood of the Works.
- c. The sale of alcoholic drinks or other intoxicating drugs/ beverages in any labour camp or in any of the buildings or encampments owned or occupied by, or within the control of the Contractor or any of his employees directly or through sub-contractors employed on the work, shall be strictly prohibited and the Contractor shall ensure strict compliance.
- d. The Contractor shall also ensure that no labour or employee is permitted to work at the site in an intoxicated state or under the influence of drugs.
- e. The Contractor shall remove, from his camp, such labour and their families, who refuse protective inoculation and vaccination when called upon to do so by the

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Engineer on the advice of the Medical Authority.

- f. Should Cholera, Plague or any other infectious disease breaks out, the Contractor shall, at his own cost, burn the huts, bedding, clothes and other belongings of or used by the infected parties.
- g. The Contractor shall promptly erect new accommodation on healthy sites as required by the Engineer within the time specified by the Engineer, failing which the work may be done by the Employer and the cost thereof recovered from the Contractor.
- h. *Periodic health checkups may be conducted. These activities may be provided by the construction contractor in consultation with State Public Health Department.*
- i. Adequate supply of fuel in the form of kerosene or LPG may be provided to construction labour, to avoid felling of trees for cooking and other household activities. No open fires may be allowed in camps.

4.8 Labour Accommodation

- a. The Contractor shall provide living accommodation for all staff employed by himself or his subcontractors that is equal to or exceeds the minimum criteria established in the following sub-sections.
- b. The buildings shall be constructed so as to have a minimum life of not less than the period of the Contract.
- c. The roofs shall be leak-proof and laid with suitable inflammable material permissible for residential use under local regulations and for which the consent of the Engineer has been obtained.
- d. Each unit shall have suitable ventilation with all doors, windows and ventilators provided with security leaves and fasteners and back to back units are to be avoided.
- e. The Contractor shall provide a suitable cooking area.
- f. The number of common toilet/bath/urinals shall be provided as per the provisions given in Section VII-4: *ESHS Manual, Part 2- Employer's Requirements.*

4.9 Water Supply

- a. The Contractor shall make his own arrangements to provide adequate potable water supply in the Camp.
- b. Where piped water supply is available, supply shall be at stand posts and where the supply is from wells or river, storage tanks of metal or other approved material shall be provided.
- c. The Contractor shall also, at his expense, make arrangements for the provision and laying of water pipe lines from the existing mains wherever available.

4.10 Drainage

- a. The Contractor shall provide efficient arrangements for draining away surface water so as to keep the camp neat and tidy.
- b. Surface water shall be drained away from paths and roads and shall not be allowed to accumulate into ditches or ponds where mosquitoes can breed.

4.11 Sanitation

- a. The Contractor shall make arrangements for conservancy and sanitation in the

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labour camps according to the rules and regulations of the Local Public Health and Medical Authorities.

- b. The Contractor shall provide a sewage disposal system that is adequate for the number of residents in the camp and which meets the norms of the local authorities.
- c. Provision of the latrines and wash places shall be in accordance with Section VII-4: *ESHS Manual, Part 2-Employer's Requirements* and as per applicable Codes and Standards. However, the layout shall be subject to consent by the Engineer.
- d. The Contractor shall be responsible for maintaining all latrines and wash places on the Site in a clean and sanitary condition and for ensuring that they do not pose a nuisance or a health threat.
- e. The Contractor shall also take such steps and make such provisions as may be necessary or as directed by the Engineer to ensure that vermin, mosquito breeding etc. are, at all times fully controlled.

(End of Appendix-5)

**APPENDIX-6 – ENVIRONMENT, SOCIAL, HEALTH AND SAFETY
REQUIREMENTS**

*Environment, Social, Health and Safety Requirements shall be as per Section VII-4: ESHS Manual, Part 2-
Employer's Requirements.*

(End of Appendix-6)

APPENDIX-7: PMIS REQUIREMENTS AND PROCEDURES

1. GENERAL

- 1.1 Timely performance is of the essence on this project. The Contractor may complete the project or any part of the Project earlier than is stipulated in the Contract and the Milestone requirements.
- 1.2 The Contractor shall devise and utilize a Project Management Information System (PMIS) such that all documents generated by the Contractor can be transmitted to the Engineer by electronic means (and vice versa) and that all documents generated by either party are electronically captured at the point of origin and can be reproduced later, electronically and in hard copy. A similar link shall also be provided between the Engineer Office at site and the Employer's site office and Headquarter Office by the Contractor.
- 1.3 All design and/or construction work, including all sub-contractors' work, under this Contract shall be planned, scheduled, executed, reported and accomplished using the precedence diagramming Critical Path Method (hereinafter referred to as CPM). The work required by this section includes the requirement to prepare, maintain, and update all detailed schedules as described in this section. The CPM schedules shall be prepared in such a manner as to permit the orderly planning, organization, and execution of the Work and be sufficiently detailed to accurately depict all the work required by the Contract. The Contractor shall resource (labor and equipment) and cost load its schedule as specified herein.
- 1.4 All schedules and schedule submittals under this Contract shall be computerized by the Contractor utilizing Professional Project Management Software, Oracle Primavera P6 or latest revision or any other software approved/instructed by Engineer capable of integrating with PMIS with the Engineer and the Employer.
- 1.5 The primary objectives of the requirements of this section are:
- 1) To ensure adequate planning and execution of the Works by the Contractor;
 - 2) To assist the Engineer in evaluating progress of the Works;
 - 3) To provide optimum coordination with other designated contractor or Sub-contractors and suppliers, within its jurisdiction.
 - 4) To permit timely prediction or detection of events or occurrences which may affect the timely execution of the Works;
 - 5) To establish a system to enable the Engineer to monitor the various activities carried out by the contractor to achieve the preset milestone to the timescale to meet the requirements of the contract document for completing the specified work in the contract.
- 1.6 The Contractor is responsible for determining the sequence of activities, the time estimates for the detailed design and construction activities and the means, methods, techniques and procedures to be employed. The schedules identified herein shall represent the Contractor's best judgment of how it will execute the Work in compliance with the Contract requirements. The Contractor shall ensure that the schedule is current and accurate and is properly and timely monitored, updated and revised as project conditions may require and as required by the Contract documents.
- 1.7 The Contractor shall provide the basic data relating to activities, durations, specified Contract Milestones, and sequences to the Engineer, as part of Contractor required schedule submittals. This data shall reflect the Contractor's actual plan for the project,

and shall fully comply with all requirements of the Contract documents.

1.8 Subject to the Engineer's agreement and unless identified elsewhere in the Contract documents, the Contractor shall determine when, where, and how it will interface with others performing work on the program and to coordinate its activities with all parties including the Employer and its consultants, suppliers and other contractors.

1.9 The Contractor shall include in the interim schedule and Contract baseline schedule all interface points with others. These points shall be in the form of start milestones for deliverables due to the Contractor from others and as Finish Milestones for deliverables that Contractor must supply to others.

2. SCHEDULER QUALIFICATIONS

The Contractor shall have within its employment or under contract, throughout the execution of the Work, such expertise in CPM scheduling and experience so as to ensure its effective and efficient performance under this Contract.

3. SCHEDULE ORIENTATION SESSION

3.1 The Contractor shall, upon notification from the Engineer, attend a schedule orientation session relating to the schedules and reports requirements for this Contract. The schedule orientation session is designed to review in detail, the objectives of the schedules and reports requirements and the contract requirements. The Contractor shall arrange for its Project Manager, superintendent, and scheduler to attend the schedule orientation session.

3.2 The following items shall be discussed during the schedule orientation session:

- 1) The procedures and requirements for the preparation of the interim schedule, contract baseline schedule, and monthly updates by Contractor;
- 2) How the requirements of the Contract documents will be monitored and enforced by the Engineer;
- 3) Long-lead items and time requirements for the Work by sub-contractors will be identified and included in the contract baseline schedule;
- 4) Work packages;
- 5) Coding and logic for the contract baseline schedule; and
- 6) Identification and scheduling of Shop Drawings and other submittals;
- 7) Listing of major project milestones;
- 8) Cost loading of major project summary activities.

4. INTERIM SCHEDULE

4.1 The Contractor shall submit its interim schedule, to the Engineer for review and acceptance at the Pre-Construction conference (or kick-off meeting for the Design portion of the project) indicating a detailed work plan for the first fifty six (56) days from the Commencement Date. Work beyond the first fifty six (56) days shall also be indicated in summary form.

4.2 The interim schedule detail plan shall include but not be limited to planned mobilization, sequence of early operations, submittals and procurement of materials and equipment. The interim schedule shall also include the following information as a minimum:

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- 1) Activity identification number of the task or event;
- 2) Description of the task or event;
- 3) Duration of the task or event;
- 4) Earliest start and finish dates for the task or event;
- 5) Latest start and finish dates for the task or event;
- 6) Various stages of Design development and Construction completion
- 7) Milestones for activities given in this document and consequent critical points for interface with others.
- 8) Logic links to previous tasks upon which the task is dependent before it can start and to subsequent tasks which are dependent on the task to be completed before they can commence

4.3 During the first fifty six (56) days following the Commencement Date, the interim schedule shall be updated regularly and submitted to the Engineer to indicate the progress of the Work, unless the contract baseline schedule is approved within fifty six (56) days of Commencement Date. Once the contract baseline schedule is accepted by the Engineer, no further updates of the interim schedule are required.

5. CONTRACT BASELINE SCHEDULE

5.1 Within forty-two (42) calendar days after the Commencement Date the Contractor shall complete the contract baseline schedule, which expands the accepted interim schedule, and submit it to the Engineer for review and acceptance. The contract baseline schedule submittal shall not show any progress until it is accepted by the Engineer.

5.2 The Contractor shall submit to the Engineer a complementary and detailed narrative description of its plan for performing the Work with the submittal of the contract baseline schedule. The narrative description shall summarize the overall approach to design and/or construction sequencing, including, but not be limited to:

- 1) The anticipated lost days due to weather;
- 2) The equipment and personnel requirements by craft to complete a resource loaded schedule;
- 3) Whether it proposes the Work be performed on single, double or triple shifts;

5.3 No application for payment shall be accepted until the contract baseline schedule is approved.

6. ACCEPTANCE OF THE INTERIM SCHEDULE AND CONTRACT BASELINE SCHEDULE

6.1 Engineer and the Contractor shall review and discuss the interim schedule or contract baseline schedule after it has been submitted to the Engineer.

6.2 the Engineer accepts the interim schedule and contract baseline schedule, these schedules will then be used to monitor and record progress of the Work, forecast completion dates, evaluate revisions and generate the payment application amounts, where applicable. Acceptance of the interim schedule or the contract baseline schedule by the Engineer shall not relieve the Contractor of total responsibility for the Contractor's means and methods, scheduling, sequencing, and prosecuting the Work to comply with the requirements of the Contract.

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- 6.3 Engineer shall have the right to require the Contractor to revise and resubmit the interim schedule and the contract baseline schedule to modify any Contractor data in the schedules or any portion of the schedules that the Engineer determines to be:
- 1) Impracticable;
 - 2) Based upon erroneous calculations or estimates;
 - 3) Unreasonable;
 - 4) Required in order to ensure proper coordination by the Contractor of the work of its Sub-contractors and with the work or services being provided by any separate contractors;
 - 5) Necessary to avoid undue interference with plant operations or those of any utility owners or adjoining property owners;
 - 6) Necessary to ensure completion of the Work by the Contract Milestones and Contract completion dates set forth in the Contract documents;
 - 7) Required in order for Contractor to comply with any other requirements of the Contract documents;
 - 8) Not in accordance with the Contractor's actual operations, unless the revision or modification will change the original scope of Works. The Contractor shall bear the expense of such revisions. If the Engineer requires such revisions, the Contractor shall revise the interim schedule or contract baseline schedule and submit it for Engineer's acceptance within seven (7) calendar days.
- 6.4 Engineer reserves the right to require that the Contractor to adjust, add to, or clarify any portion of the schedules that may be determined to be insufficient for monitoring of the Work after the schedules are accepted. No additional compensation shall be provided for such adjustments, additions or clarifications.

7. SCHEDULE CONTENT AND FORMAT

- 7.1 All construction activity durations shall be given in working days. The Contractor shall develop activities for the schedules so that no single activity shown has duration longer than fourteen (14) working days, except for procurement and fabrication, delivery, submittal development and approval activities that may have longer durations.
- 7.2 For all equipment and materials to be fabricated or supplied for the Project, the contract baseline schedule shall show a sequence of activities including:
- 1) Material delivery and storage;
 - 2) Erection or installation;
 - 3) Testing of equipment and materials.
- 7.3 The interim schedule and contract baseline schedule shall show dependencies (or relationships) between each activity. Each activity must have a successor and predecessor, except for the project start and finish milestone. The use of date constraints shall be limited to Contract milestones and Contract completion dates only.
- 7.4 The interim schedule and contract baseline schedule shall contain or be able to demonstrate that the following items have been addressed:
- 1) The Project's name;
 - 2) The Contractor's name;

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- 3) Revision or edition number;
- 4) Activities of completed work;
- 5) Activities relating to different areas of responsibility, such as subcontracted Work which is distinctly separated from that being done by the Contractor directly;
- 6) Labour resources distinguished by craft or crew requirements;
- 7) Equipment and material resources distinguished by equipment and material requirements;
- 8) Distinct and identifiable subdivisions of work such as structural slabs, beams, columns;
- 9) Locations of work within the contract limit lines that necessitates different times or crews to perform;
- 10) Outage schedules for existing utility services that will be interrupted during the performance of the Work;
- 11) Acquisition and installation of equipment and materials supplied and/or installed by the owner or its separate contractors;
- 12) Material to be stored on Site;
- 13) Phases;
- 14) Interim milestones and the Contract Completion dates.

7.5 The Contractor shall be responsible for expediting the delivery of all materials and equipment to be furnished by the Contractor so that the progress of construction shall be maintained according to the currently accepted contract baseline schedule for the Works. The Contractor shall notify the Engineer in writing, and in a timely manner, whenever the Contractor anticipates that the delivery date of any material or equipment will be later than the delivery date indicated by the currently accepted contract baseline schedule.

8. MONTHLY SCHEDULE UPDATE

8.1 An update of the accepted interim schedule or contract baseline schedule shall be submitted by the Contractor to the Engineer monthly and with the monthly application for payment. Receipt by the Engineer of the monthly schedule update will be an express condition precedent to processing each invoice.

8.2 On a monthly basis, the Contractor shall arrange for its Project Manager, superintendent, and scheduler to meet at the project Site with the Engineer to review Contractor's monthly schedule update. The schedule will be marked-up to show the agreed upon progress, signed by the Contractor, and a signed copy issued to the Project Manager. The monthly schedule update shall show up-to-date and accurate progress of the Works, and shall forecast the completion date for activities in progress based on the contract baseline schedule. The monthly schedule update shall be prepared by the Contractor in consultation with all its principal sub- contractors and suppliers.

8.3 The monthly schedule update shall include actual activity data for progress to date, but in the monthly schedule update, the Contractor shall not change the schedule logic, the activity relationships/dependencies, or planned activity durations and shall not add or delete activities. If the Contractor believes that any of these items should be changed, then a proposed revised baseline schedule must be submitted by the Contractor to the Engineer. Although activities shall not be added or deleted in the monthly schedule update, activities associated with Work authorizations that have been recommended for approval shall be included in the next monthly schedule update.

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- 8.4 The Contractor will be notified by the Engineer, in writing, as to acceptance, reasons for rejection, or any revisions required to the schedules. Changes to the schedules agreed upon by the Contractor and the Engineer shall be incorporated by the Contractor into the schedules within seven (7) calendar days after agreement.
- 8.5 The monthly schedule update shall show actual activity commencement and completion dates, the actual remaining duration in workdays and physical percent complete for those activities commenced and not complete. For the stored materials, the update shall show the amount of material stored, representing the total cost of the materials delivered and properly stored. The monthly schedule update shall also show a graphic comparison of the current status and the baseline plan for each activity in the network.
- 8.6 Each monthly schedule update shall continue to show all work activities including those already completed. These completed activities shall accurately reflect "as built" information by indicating when activities were actually started and completed.
- 8.7 Monthly schedule updates shall also contain the following information for each activity:
- 1) Activity identification number, description and estimated original duration in workdays;
 - 2) Calculated early and late finish dates;
 - 3) Actual start and actual finish dates, and remaining duration, in calendar, for those activities started and not completed;
 - 4) Days ahead and/or behind schedule of the milestones representing the specified Contract Milestones and Contract completion dates;
 - 5) Physical percent complete for each activity;
 - 6) A float analysis of the longest path through the schedule detailing potential delays and areas for acceleration. Actual start and finish dates shall be indicated for each activity as appropriate. Completed activities will be omitted from remaining float and late start slots.

9. REVISED BASELINE SCHEDULE

- 9.1 If the current contract baseline schedule or monthly schedule update no longer represents the actual or planned execution and progress of the Work, the Contractor shall submit a proposed revision to the current contract baseline schedule to the employer in accordance with the section at no additional cost. If the Engineer believes that the current contract baseline schedule or monthly schedule update no longer represents the actual or planned execution and progress of the Work, the Contractor shall submit, a proposed revision to the current contract baseline schedule to the employer in accordance with this section at no additional cost.
- 9.2 Schedule Revisions, as defined herein, shall refer to modifications made to activities in the accepted interim schedule or contract baseline schedule in any of the following items:
- 1) Activity duration;
 - 2) Changes in logic connections between activities;
 - 3) Changes in constraints;
 - 4) Changes in value loading;
 - 5) Changes to activity descriptions;

6) Activity additions and deletions.

9.3 Any proposed revisions to the contract baseline schedule must be submitted to the Engineer for acceptance. This submittal must include, at a minimum, a written narrative with a full description and reasons for each work activity revised a full schedule printout, and a soft copy of the proposed revised contract baseline schedule. For revisions affecting the sequence of work, the Contractor shall provide a schedule diagram Fragmented Network (Fragnet) which compares the original sequence to the revised sequence of work. This diagram shall maintain the Contract Milestone and Contract completion dates.

10. RECOVERY SCHEDULE

10.1 Should the updated interim schedule, contract baseline schedule or monthly schedule update, at any time during Contractor's performance, show that the Contractor is fourteen (14) or more calendar days behind schedule for any Contract interim Milestone, substantial completion or for Contract completion, the Contractor shall prepare a recovery schedule separate from the updated and approved monthly schedule update explaining and displaying how the Contractor intends to reschedule its work in order to regain compliance with the contract baseline schedule during the immediate subsequent pay period.

10.2 If a recovery schedule is required, the Contractor shall prepare and submit to the Engineer a recovery schedule, incorporating the best available information from sub-contractors and others, which will permit the forecasted completion dates to return to the interim milestones and the Contract completion dates. The Contractor shall prepare a recovery schedule to the same level of detail as the originally accepted contract baseline schedule submittal.

10.3 Within seven (7) working days after submission of the recovery schedule, the Contractor shall meet with the Engineer to review and evaluate the recovery schedule. Within seven (7) working days of that meeting, the Contractor shall submit the recovery schedule, including any revisions necessitated by the review, to the Engineer for its review and acceptance. The recovery schedule, once accepted by the Engineer, shall be implemented as the revised contract baseline schedule for the remaining Work.

(End of Appendix-7)

APPENDIX-8: LIST OF LEVEL CROSSING

Sr. No	LC. No.	Chainage
1		NIL

(End of Appendix-8)

**APPENDIX-9: ENVIRONMENT, SOCIAL, HEALTH AND SAFETY
(ESHS) METRICS FOR PROGRESS REPORTS**

The Contractor shall submit the ESHS reports as per the requirements given in Section VII-4: ESHS Manual, Part 2, Employer's Requirements.

(End of Appendix-9)

APPENDIX-10: LIST OF BRIDGES

The indicative list of major bridges in Prithla – Harsana Kalan section and connections are as under. The actual number of bridges and their configuration may be ascertained by the Contractor through actual site survey and through interface with concerned CST Contractors. Contractor shall carry out interface with CST contractors for bridge mast arrangement and other suitable arrangement for installation of OHE.

A: MAJOR BRIDGE LIST OF MAIN LINE FOR HORC PROJECT

SN	BR. No	Chainage (m)	Type of Bridge	Span Configuration	Bank Height (m)
1	11	1,696.625	PSC U-SLAB	1X12.2	6.11
2	15	3,476.865	PSC U-SLAB	1X12.2	5.70
3	16	4,242.015	OWG	4X30.5	6.27
4	17	4,376.033	PSC U-SLAB	1X12.2	6.78
5	25	7,759.415	PSC U-SLAB	1X12.2	7.04
6	27	8,036.572	OWG	1X61	5.88
7	29	8,298.329	Composite	1X30.5	8.25
8	33	9,537.119	PSC I Girder	1X30.5	5.69
9	46	11,543.737	OWG	2X76.2	6.85
10	54	14,472.344	Composite	2X24.4	6.93
11	85	33,673.535	PSC U-Slab	1X12.2	5.66
12	87	34,899.536	PSC U-Slab	3x12.2	5.51
13	90	36,984.623	PSC U-Slab	1x12.2	5.64
14	93	38,457.244	PSC U-Slab	1X12.2	5.73
15	95	40,003.961	PSC U-Slab	1X12.2	5.75
16	106	44,246.256	PSC I Girder	1X18.3	11.55
17	111	45,496.699	OWG + Composite	4X18.3 +1X30.5 +8X24.4 + 1X76.2 +2X24.4+1X 61	6.96
18	123	48,664.440	PSC I Girder	1X18.3	5.21
19	134	54,505.980	OWG	1X76.2	6.66
20	136	55,719.028	CG+ OWG	(1x24.4)+(1X 76.2) +(1x24.4)	12.08
21	154	61,676.032	OWG, Composite	(2x24.4)+(1x4 5.7) +(4x24.4)	8.93
22	177	68,213.000	PSC U SLAB	1X12.2	5.65
23	178	68,450.000	RCC Pipe	1X1.8	4.66
24	182	69,684.000	PSC U SLAB	1X12.2	5.65
25	183	69,838.000	Composite Girder	2X30.5	9.33
26	184	70,234.000	PSC U SLAB	1X12.2	5.00
27	199	74,622.000	OWG	(1X76.2)+(1 X45.7) +(1X76.2)	5.74
28	200	74,888.000	PSC U SLAB	1X12.2	7.23
29	206	77,547.000	PSC U SLAB	1X12.2	5.72
30	207	77,623.000	PSC U SLAB	2X12.2	5.73
31	214	79,053.209	PSC U SLAB	2X12.2	5.51

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32	219	80,182.716	PSC U SLAB	1X12.2	3.79
33	223	81,282.713	PSC U SLAB	1X12.2	4.36
34	224	81,356.937	Composite	1x18.3	5.13
35	228	82,134.530	PSC U SLAB	2X12.2	6.13
36	233	83,056.241	Composite	1X30.5	2.76
37	234	83,236.296	PSC U SLAB	1X12.2	5.33
38	241	84,506.206	OWG	(3X18.3)+(1X61)	6.10
39	246	85,858.749	OWG	1X30.5	5.24
40	247	86,017.943	PSC U SLAB	1X12.2	4.61
41	249	86,543.863	PSC U SLAB	1X12.2	5.68
42	250	86,783.861	PSC U SLAB	1X12.2	5.60
43	256	89,079.505	OWG	1X30.5	6.64
44	258	89,505.336	Composite	1X30.5	7.85
45	259	89,629.052	PSC U SLAB	1X12.2	7.61
46	266	91,965.902	OWG	(1X24.4)+(1X45.7) +(1X24.4)	6.45
47	272	93,141.460	OWG	(1X61)+(1X45.7)	7.01
48	277	94,382.321	OWG	3X30.5	8.82
49	279	94,725.364	Composite	1X18.3	10.10
50	280	94,864.920	Composite, PSC U SLAB	(1X12.2)+(1X24.4) +(1X12.2)	8.32
51	282	95,456.349	PSC U SLAB	1X12.2	6.82
52	286	96,516.613	OWG	1X45.7	4.11
53	296	99,227.902	PSC U SLAB	1X12.2	5.67
54	298	99,719.795	Composite, PSC U SLAB	(1X12.2)+(2X30.5) +(1X12.2)	4.21
55	305	1,01,091.292	OWG		7.44
56	308	1,01,627.564	PSC U SLAB	1X12.2	3.92
57	312	1,02,702.818	PSC U SLAB	2X12.2	4.07
58	329	1,06,828.846	PSC U SLAB	1X12.2	5.43
59	346	1,11,211.933	OWG	6X30.5	8.27
60	348	1,11,729.547	PSC U SLAB	1X12.2	7.19
61	351	1,12,351.582	PSC U SLAB	1X12.2	4.61
62	352	1,12,990.829	PSC U SLAB	1X12.2	4.93
63	372	1,17,497.378	PSC U SLAB	1X12.2	5.88
64	374	1,18,380.419	PSC U SLAB	1X12.2	12.25
65	375	1,18,626.180	OWG	2X61	8.16
66	378	1,19,574.924	PSC SLAB	1X12.2	6.91
67	383	1,20,863.049	OWG	1X30.5	6.23
68	389	1,23,140.157	PSC SLAB	1X12.2	6.38
69	390	1,23,239.082	OWG	2X30.5	6.98

B: MAJOR BRIDGE LIST OF HORC (CONNECTING LINE)

SN	BR. No	Chainage	Type of Crossing	Type of Bridge	Span Configuration
NEW PATLI TO PATLI (C-2)					
1	147(A)	1,200.000	RUB	OWG	1X45.7
NEW PRITHLA TO PRITHLA (C-5)					
2	3	-821.629	Composite	RCC Box	(1x6.7x5.5) +(1x24.4)+(16x5.5)

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MANDOTHI TO ASAUDHA (C-6)					
3	5	2678.217	COMPOSITE GIRDER	OWG	1X24.4X5.6
4	6	2781.434	RUB, COMPOSITE GIRDER	OWG	1X24.4X5.6
MEWAT TO DHULAWAT(C-3)					
5	1	1240		OWG	4X45.7
6	4	2032		OWG	2X30.5
7	5	2157		PSC U SLAB	1X12.2

(End of Appendix-10)

APPENDIX-11: LIST OF TRANSMISSION LINES 66KV AND ABOVE

The indicative list of power line crossings, 66 kV and above, crossing the HORC lines are given below. The list 'A' crossings have been modified and have adequate clearances from Rail level and list "B" crossings are under the process of modification by HRIDC and shall be modified in due course. Contractor to carry out the survey of these crossing and design shall be carried out while considering these indicative crossings.

A: Power Line Crossings 66 kV and above (modified) (indicative)

Sr. No.	Section	Feeder	Voltage KV	Owner	HORC CH
1	C1	Sec-95	220 KV	HVPNL	50+660
2	C1	Sec-95	220 KV	HVPNL	52+930
3	C1	Sec-95	220 KV	HVPNL	52+970
4	C1	Sec-95	220 KV	HVPNL	4+294
5	C2	Agra - Jhatikra Line	765 KV	PGCIL	60+020
6	C2	Sec-95 - Mau Line	220 KV	HVPNL	2+590
7	C2	Agra - Jhatikra Line	765 KV	PGCIL	2+000
8	C2	Dhanonda - Daulatabad Line	400 KV	HVPNL	3+800
9	C2	Dhanonda - Daulatabad Line	400 KV	HVPNL	3+380
10	C3	Agra - Jhatikra Line	765 KV	PGCIL	36+060
11	C 4	Agra - Jhatikra Line	765 KV	PGCIL	28+200
12	C 5	BTPS-Alwar	220 KV	HVPNL	00+815
13	C 5	Prithla - Kaderpur Line	400 KV	GPTL	03+070
14	C 5	Ballabgarh - Agra Line	400 KV	PGCIL	05+676
15	C 6	Kanpur - Jhatikra Line	765 KV	PGCIL	63+637
16	C 6	Khetri - Jhatikra Line	765 KV	PGCIL	63+900
17	C 6	Nimribali (Bhiwani)	765 KV	PGCIL	70+770
18	C 6	Jhajjar - Mundka Line	400 KV	APCPL	81+313
19	C 6	Bahadurgarh - Sampla Line	400 KV	PGCIL	88+000
20	C 6	Bawana - Bahadurgarh	400 KV	PGCIL	89+627
21	C 6	Asaudha - Allied Strips Line	132 KV	HVPNL	94+685
22	C 6	JHJI - Rai Line	220 KV	HVPNL	123+381
23	C 6	KAB - DIP Line	400 KV	HVPNL	126+310

B: Power Line Crossings 66 kV and above (unmodified) (indicative)

Sr. No.	Section	Feeder	Voltage KV	Owner	HORC CH
1	C1	Manesar-Pataudi	66 kV	HVPNL	50+040
2	C1	Sec 95-Mau line LILO at Transport Nagar	220 kV	HVPNL	53+000
3	C1	Harsaru-Pataudi line	66 kV	HVPNL	54+400
4	C1	Sec 95-Mau line	220 kV	HVPNL	54+825
5	C2	Harsaru-Farukhnagar line	66 kV	HVPNL	59+195
6	C2	Dadri-Samaypur-bahadurgarh line	220 kV	BBMB	59+280

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7	C2	Dhanonda-Daulatabad line	400 kV	HVPNL	60+210
8	C2	Sec 95-Mau line	220 kV	HVPNL	01+860
9	C3	Taudu-Mehmoodpur Ahil line	66 kV	HVPNL	33+340
10	C3	Badshahpur-Rewari line	220 kV	HVPNL	41+200
11	C3	Manesar-Neemranan line	400 kV	PGCIL	44+030
12	C3	Panchgaon-Farukhnagar line on 220 KV Multicircuit tower	66 kV	HVPNL	44+270
13	C3	Sohna-Tauru line	66 kV	HVPNL	02+100
14	C3	Kanpur-Jhatikra line	765 kV	PGCIL	02+950
15	C4	Agra-Jhatikra line	765 kV	PGCIL	28+200
16	C4	Sohna-Tauru line	66 kV	HVPNL	29+350
17	C5	Gurgaon-Rangala Rajpur line	220 kV	HVPNL	16+850
18	C5	Sec-72-Rangala Rajpur LILO line (IMT Sohna)	220 kV	HVPNL	19+950
19	C5	Sohna-Nuh Nagina line	66 kV	HVPNL	20+500
20	C6	Jharli-Daulatabad line	400 kV	HVPNL	63+220
21	C6	Badli-Badsa line	132 kV	HVPNL	73+886
22	C6	Badhana- Nunamajran line	132 kV	HVPNL	84+136
23	C6	Sampla-Bahadurgarh line	220 kV	HVPNL	90+910
24	C6	Bahadurgarh-Bawana-Bhiwani line	400 kV	PGCIL	100+808

(End of Appendix-11)

APPENDIX-12: LIST OF POWER LINE CROSSING 33KV AND BELOW

The indicative list of power line crossings, 33 kV and below, crossing the HOCR lines are given below. These crossings are being modified through underground cables and these crossings are under the process of modification by HRIDC and work shall be completed in due course. Contractor to carry out the survey of these crossing and foundation design shall be carried out while considering these indicative crossings.

Sr. No.	Feeder Description	Owner/ Authority	Voltage (kV)	HOCR CH
1	HT Line Shifting with 22 Nos Pole	DHBVNL	11 KV	(-1+500) To (-2+200)
2	HT CROSSING 11 KV (UG)+5 Nos pole shifting	DHBVNL	11 KV	(-1+280)
3	HT Crossing 11 KV (UG)	DHBVNL	11 KV	(-900)
4	HT Crossing 11 KV (UG)	DHBVNL	11 KV	(-320)
5	Ht crossing 11KV(UG)+T/F(25KVA) shifting+3 nos pole	DHBVNL	11 KV	0+130
6	HT Crossing 11 KV (UG) T/F 25KVA+ 5 NoS Pole	DHBVNL	11 KV	0+900
7	HT Crossing 11 KV (UG)& 1 POLE SHIFTING	DHBVNL	11 KV	0+920
8	HT Crossing 11 KV (UG)5 Pole shifting+T/F 25kVa	DHBVNL	11 KV	2+150
9	HT Crossing 11 KV (UG) T/F 25KVA+ 1 NoS Pole	DHBVNL	11 KV	2.400
10	HT Crossing 11 KV (UG)& 1 POLE SHIFTING	DHBVNL	11 KV	2.800
11	HT Crossing 11 KV (UG)& 1 POLE SHIFTING	DHBVNL	11 KV	3.500
12	HT Crossing 11 KV (UG)& 1 POLE SHIFTING	DHBVNL	11 KV	3.600
13	HT Crossing 11 KV (UG)	DHBVNL	11 KV	4.150
14	HT Crossing 11 KV (UG) & 14 POLE SHIFTING	DHBVNL	11 KV	4.150
15	HT Crossing 11 KV(UG)	DHBVNL	11 KV	5+150
16	LT Crossing (UG)	DHBVNL	440 V	5+800
17	HT Crossing 11 KV(UG) & 3 Nos pole shifting	DHBVNL	11 KV	6+100
18	LT Crossing (UG)+T/F Shifting +7 Pole shifting	DHBVNL	440 V	6+600
19	HT Crossing 11KV(UG)+T/F shifting+2Nos Pole	DHBVNL	11 KV	6+900
20	HT Crossing 11KV(UG)+T/F shifting+4Nos Pole shifting	DHBVNL	11 KV	7+100
21	HT Crossing 11KV(UG)+T/F shifting+2Nos Pole shifting	DHBVNL	11 KV	8+500
22	HT Crossing 11KV(UG)	DHBVNL	11 KV	10+000
23	HT Crossing 11KV(UG) & 4 Nos Pole Shifting	DHBVNL	11 KV	10+900
24	HT line shifting with T/F 11KV(UG) & 4 Nos Pole Shifting	DHBVNL	11 KV	11+200
25	HT crossing 11 kV(UG)	DHBVNL	11 KV	14+050
26	HT crossing 11 kV(UG)	DHBVNL	11 KV	16+400
27	HT crossing 11 kV(UG)+3 POLE	DHBVNL	11 KV	16+500

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	SHIFTING			
28	HT crossing 11 kV(UG)+4 POLE SHIFTING	DHBVNL	11 KV	16+700
29	HT Crossing 11 kV(UG)	DHBVNL	11 KV	19450
30	HT Crossing 33 KV (UG)	DHBVNL	33 KV	19450
31	HT Crossing 33 KV (UG)	DHBVNL	33 KV	19520
32	HT Crossing 33 KV (UG)	DHBVNL	33 KV	19525
33	HT Crossing 11 kV(UG)	DHBVNL	11 KV	19+600
34	HT Crossing 33 KV (UG)- DC	DHBVNL	33 KV	19+700
35	HT Crossing 33 KV (UG)- DC	DHBVNL	33 KV	19+710
36	HT Crossing 33 KV (UG)	DHBVNL	33 KV	19+720
37	HT Crossing 33 KV (UG)- DC	DHBVNL	33 KV	19+730
38	HT Crossing 11 kV(UG)	DHBVNL	11 KV	20+220
39	HT Crossing 11 kV(UG) & t/f shifting with 5nos pole	DHBVNL	11 KV	20+300
40	2 Nos. HT Crossing 33 KV (UG) & Approx 800 mtr Shifting 33 KV-DC	DHBVNL	33 KV	20+300 to 21+000
41	HT Crossing 33 KV (UG)- DC	DHBVNL	33 KV	21+000
42	HT Crossing 11 kV(UG) DC	DHBVNL	11 KV	20+500 to 20+700
43	HT Crossing 11 kV(UG)	DHBVNL	11 KV	22+300
44	HT Crossing 11kV(UG) -DC	DHBVNL	11 KV	22+800
45	HT Crossing 11kV(UG)	DHBVNL	11 KV	22+900
46	HT Crossing 11kV(UG)	DHBVNL	11 KV	22+400
47	HT Crossing 11kV(UG) & 3 nos pole shifting	DHBVNL	11 KV	22+420
48	HT Crossing 11 kV(UG)	DHBVNL	11 KV	28+900
49	LT Crossing (UG)	DHBVNL	440 V	28+920
50	LT Crossing (UG)	DHBVNL	440 V	28+960
51	HT Crossing 11 kV(UG)	DHBVNL	11 KV	29+500
52	HT Crossing 11 kV(UG)	DHBVNL	11 KV	29+500
53	HT Crossing 11 kV(UG)	DHBVNL	11 KV	29+700
54	HT Line shifting	DHBVNL	11 KV	30+200
55	HT Crossing 11 kV(UG)	DHBVNL	11 KV	30+300
56	HT Crossing 11 kV(UG)	DHBVNL	11 KV	30+500
57	LT Crossing (UG)	DHBVNL	440 V	30+520
58	HT Crossing 11 kV(UG)	DHBVNL	11 KV	30+900
59	HT Line shifting with Transformer	DHBVNL	11 KV	31+000
60	2 Nos. HT Crossing 33 KV (UG) & Approx 800 mtr Shifting 33 KV-DC	DHBVNL	33 KV	31+000 & 0+600
61	HT Crossing 33 KV (Ug)	DHBVNL	33 KV	31+010
62	LT Line Crossing Underground	DHBVNL	440 V	0+820
63	LT Line Crossing Underground	DHBVNL	440 V	1+400
64	HT Crossing 11 KV (Ug)	DHBVNL	11 KV	1+550
65	LT Overhead Line With 2 Nos Pole	DHBVNL	440 V	1+900
66	LT Line Crossing Underground	DHBVNL	440 V	2+180
67	LT Line Crossing Underground	DHBVNL	440 V	2+260
68	HT Line 11 KV Overhead With 4 Nos Pole	DHBVNL	11 KV	2+300
69	LT Line Crossing Underground	DHBVNL	440 V	2+470
70	HT Crossing 11 KV (Ug)& Shifting 63 KVa T/F	DHBVNL	11 KV	3+200
71	HT Crossing 11 KV (UG)	DHBVNL	11 KV	3+300
72	LT Crossing (UG)	DHBVNL	440 V	31+020
73	LT Crossing (UG)	DHBVNL	440 V	31+150

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74	LT Crossing (UG)	DHBVNL	440 V	31+550
75	LT Crossing (UG)	DHBVNL	440 V	31+800
76	HT Crossing 11 kV(UG)	DHBVNL	11 KV	32+500
77	HT Crossing 11 kV(UG)	DHBVNL	11 KV	32+520
78	HT Crossing 11 kV(UG)	DHBVNL	11 KV	33+450
79	HT Line shifting with 2 Nos Transformer	DHBVNL	11 KV	33+600
80	HT Crossing 11 kV(UG)	DHBVNL	11 KV	33+800
81	LT Crossing (UG)	DHBVNL	440 V	33+880
82	HT Crossing 11 kV(UG)	DHBVNL	11 KV	34+100
83	HT Crossing 11 kV(UG)	DHBVNL	11 KV	34+690
84	HT Crossing 11 kV(UG)	DHBVNL	11 KV	34+700
85	HT Crossing 11 kV (UG)	DHBVNL	11 KV	34+710
86	HT Crossing 11 kV (UG)	DHBVNL	11 KV	34+720
87	HT Crossing 11 kV (UG)	DHBVNL	11 KV	35+550
88	LT Crossing (UG)	DHBVNL	440 V	35+800
89	LT Crossing (UG)	DHBVNL	440 V	36+000
90	LT Crossing (UG)	DHBVNL	440 V	36+500
91	HT Crossing 11 kV(UG)	DHBVNL	11 KV	36+700
92	HT Line shifting with Transformer	DHBVNL	11 KV	36+750
93	HT Shifting with Pole	DHBVNL	11 KV	37+120
94	LT Crossing (UG)	DHBVNL	440 V	38+100
95	LT Crossing (UG)	DHBVNL	440 V	38+760
96	LT Crossing (UG)	DHBVNL	440 V	38+900
97	HT Line Shifting with Transformer	DHBVNL	11 kV	39+220
98	HT Crossing 11 kV(UG)	DHBVNL	11 KV	39+800
99	HT Crossing 33 KV (UG)	DHBVNL	33 KV	39+820
100	HT Crossing 33 KV (UG)	DHBVNL	33 KV	39+850
101	HT Crossing 11 kV(UG)	DHBVNL	11 KV	39+900
102	LT Crossing (UG)	DHBVNL	440 V	40+000
103	HT Line with Transformer	DHBVNL	11 KV	40+750
104	LT Crossing (UG)	DHBVNL	440 V	41+250
105	LT Crossing (UG)	DHBVNL	440 V	41+830
106	11 kV OH wires with H-Tx in KMP ROW	DHBVNL	11 KV	42+950
107	11 kV OH wires	DHBVNL	11 KV	43+030
108	11 KV OH wires H-Tx for House & Diary	DHBVNL	11 KV	43+150
109	11 KV OH wires crossing	DHBVNL	11 KV	43+150
110	Parallel to Pachgaon Tauru road.	DHBVNL	11 KV	40+320
111	2 Utilities of 11kV side shift with 2 Tx. Shifting	DHBVNL	11 KV	43+350
112		DHBVNL	11 KV	44+070
113		DHBVNL	11 KV	44+700
114	11 KV OH wires crossing	DHBVNL	11 KV	44+700
115	11 KV OH wires H-Tx near Manesar Toll Palza	DHBVNL	11 KV	44+730
116	11 KV OH wires crossing	DHBVNL	11 KV	44+780
117	11 kV OH wires crossing cloverleaf	DHBVNL	11 KV	44+880
118	B/w Cloverleaf & NH-8 Palwal side	DHBVNL	11 KV	45+300
119	11 kV OH wires with H-poles b/w UG Through NH-8 & Cloverleaf Under Pass	DHBVNL	11 KV	45+420
120	11 kV OH wires with H-pole Kmp side Pole on II to NH-8	DHBVNL	11 KV	45+420
121	11 kV OH wires with H-pole Kmp	DHBVNL	11 KV	45+540

**Part 2, Section VII-1: Employer's Requirements – General Specifications (GS)- 2x25 kV AC Traction
Electrification and associated work**

	side Pole on II to NH-8			
122	11 kV OH wires 2 H-Pole with 2 Tx	DHBVNL	11 KV	45+600
123	11 kV OH wires	DHBVNL	11 KV	46+550
124	11 kV OH wires	DHBVNL	11 KV	47+150
125	11 kV OH wires	DHBVNL	11 KV	47+300
126	11 kV OH wires	DHBVNL	11 KV	48+300
127	11 KV OH wires crossing near wine shop	DHBVNL	11 KV	50+700
128	11 kV OH wire crossing	DHBVNL	11 KV	52+820
129	11 kV OH wire crossing	DHBVNL	11 KV	53+650
130	LT Crossing (UG)	DHBVNL	11 KV	53+700
131	11 kV OH wire crossing	DHBVNL	11 KV	54+100
132	11 kV OH wire crossing	DHBVNL	11 KV	54+820
133	11 kV OH wire crossing	DHBVNL	11 KV	55+014
134	11 kV OH wire crossing	DHBVNL	11 KV	55+100
135	11 kV OH wire crossing with Transformer shifting near ware house location	DHBVNL	11 KV	2+950
136	LT Crossing (UG)	DHBVNL	440 V	3+380
137	LT Crossing (UG)	DHBVNL	440 V	3+610
138	LT Crossing (UG)	DHBVNL	440 V	3+650
139	11 kV OH wire crossing	DHBVNL	11 KV	55+860
140	11 kV OH wire crossing	DHBVNL	11 KV	55+970
141	11 kV OH wire crossing	DHBVNL	11 KV	56+140
142	LT Crossing (UG)	DHBVNL	440 V	1+600
143	LT Crossing (UG)	DHBVNL	440 V	1+900
144	11 kV OH wire crossing	DHBVNL	11 KV	2+100
145	11 kV OH wire crossing	DHBVNL	11 KV	56+145
146	11 kV OH wire crossing	DHBVNL	11 KV	56+515
147	11 kV OH wire crossing	DHBVNL	11 KV	57+830
148	11 kV OH wire crossing	DHBVNL	11 KV	57+900
149	LT Crossing (UG)	DHBVNL	440 V	1+500
150	LT Crossing (UG)	DHBVNL	440 V	1+670
151	LT Crossing (UG)	DHBVNL	440 V	1+960
152	11 kV OH wire crossing	DHBVNL	11 KV	1+970
153	11 kV OH wire crossing	DHBVNL	11 KV	1+975
154	LT Crossing (UG)	DHBVNL	440 V	2+100
155	11 kV OH wire crossing	DHBVNL	11 KV	3+000
156	LT Crossing (UG)	DHBVNL	440 V	3+430
157	11 kV OH wire crossing	DHBVNL	11 KV	3+450
158	11 kV OH wire crossing	DHBVNL	11 KV	3+550
159	11 kV OH wire crossing	DHBVNL	11 KV	3+700
160	11 kV OH wire crossing	DHBVNL	11 KV	3+940
161	11 kV OH wire crossing	DHBVNL	11 KV	4+230
162	11 kV OH wire crossing	DHBVNL	11 KV	4+240
163	LT Crossing (UG)	DHBVNL	440 V	58+660
164	11 kV OH wire crossing	DHBVNL	11 KV	58+940
165	11 kV OH wire crossing	DHBVNL	11 KV	59+050
166	11 kV OH wire crossing	DHBVNL	11 KV	59+250
167	11 kV OH wire crossing	DHBVNL	11 KV	59+470
168	LT Crossing (UG)	DHBVNL	440 V	59+600
169	11 kV OH wire crossing	DHBVNL	11 KV	59+890
170	11 kV OH wire crossing	DHBVNL	11 KV	59+895
171	11 kV OH wire crossing	DHBVNL	11 KV	60+430
172	11 kV OH wire crossing	DHBVNL	11 KV	60+770
173	11 kV OH wire crossing	DHBVNL	11 KV	61+550

**Part 2, Section VII-1: Employer's Requirements – General Specifications (GS)- 2x25 kV AC Traction
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174	11 kV OH wire crossing	DHBVNL	11 KV	61+560
175	11 kV OH wire crossing	UHBVNL	11 KV	72+860
176	11 kV OH wire crossing	UHBVNL	11 KV	73+100
177	33 kV OH wire crossing	UHBVNL	33 KV	73+100
178	33 kV OH wire crossing	UHBVNL	33 KV	73+140
179	11 kV OH wire crossing	UHBVNL	11 KV	73+160
180	11 kV OH wire crossing	UHBVNL	11 KV	73+550
181	11 kV OH wire crossing	UHBVNL	11 KV	73+920
182	11 kV OH wire crossing	UHBVNL	11 KV	73+925
183	11 kV OH wire crossing	UHBVNL	11 KV	75+920
184	11 kV OH wire crossing	UHBVNL	11 KV	75+940
185	33 kV OH wire crossing	UHBVNL	33 KV	77+620
186	33 kV OH wire crossing	UHBVNL	33 KV	77+640
187	11 kV OH wire crossing	UHBVNL	11 KV	84+300
188	11 kV OH wire crossing	UHBVNL	11 KV	84+470
189	11 kV OH wire crossing	UHBVNL	11 KV	84+475
190	11 kV OH wire crossing	UHBVNL	11 KV	84+498
191	11 kV OH wire crossing	UHBVNL	11 KV	84+700
192	11 kV OH wire crossing	UHBVNL	11 KV	88+988
193	11 kV OH wire crossing	UHBVNL	11 KV	89+000
194	33 kV OH wire crossing	UHBVNL	33 KV	89+005
195	33 kV OH wire crossing	UHBVNL	33 KV	89+005
196	11 kV OH wire crossing	UHBVNL	11 KV	80+010
197	11 kV OH wire crossing	UHBVNL	11 KV	92+920
198	11 kV OH wire crossing	UHBVNL	11 KV	92+990
199	33 kV OH wire crossing	UHBVNL	33 KV	93+000
200	33 kV OH wire crossing	UHBVNL	33 KV	93+100
201	11 kV OH wire crossing	UHBVNL	11 KV	94+550
202	11 kV OH wire crossing	UHBVNL	11 KV	96+530
203	33 kV OH wire crossing	UHBVNL	33 KV	97+400
204	33 kV OH wire crossing	UHBVNL	33 KV	97+440
205	11 kV OH wire crossing	UHBVNL	11 KV	97+738
206	11 kV OH wire crossing	UHBVNL	11 KV	97+763
207	11 kV OH wire crossing	UHBVNL	11 KV	97+763
208	11 kV OH wire crossing	UHBVNL	11 KV	98+630
209	11 kV OH wire crossing	UHBVNL	11 KV	98+900
210	11 kV OH wire crossing	UHBVNL	11 KV	98+940
211	11 kV OH wire crossing	UHBVNL	11 KV	98+950
212	11 kV OH wire crossing	UHBVNL	11 KV	104+620
213	33 kV OH wire crossing	UHBVNL	33 KV	106+550
214	33 kV OH wire crossing	UHBVNL	33 KV	110+000
215	11 kV OH wire crossing	UHBVNL	11 KV	110+930
216	11 kV OH wire crossing	UHBVNL	11 KV	111+100
217	11 kV OH wire crossing	UHBVNL	11 KV	113+160
218	33 kV OH wire crossing	UHBVNL	33 KV	112+100
219	33 kV OH wire crossing	UHBVNL	33 KV	112+200
220	11 kV OH wire crossing	UHBVNL	11 KV	115+480
221	11 kV OH wire crossing	UHBVNL	11 KV	115+950
222	11 kV OH wire crossing	UHBVNL	11 KV	116+250
223	11 kV OH wire crossing	UHBVNL	11 KV	116+550
224	33 kV OH wire crossing	UHBVNL	33 KV	119+100
225	33 kV OH wire crossing	UHBVNL	33 KV	119+130
226	11 kV OH wire crossing	UHBVNL	11 KV	120+680
227	11 kV OH wire crossing	UHBVNL	11 KV	120+780
228	33 kV OH wire crossing	UHBVNL	33 KV	122+172
229	33 kV OH wire crossing	UHBVNL	33 KV	122+200
230	11 kV OH wire crossing	UHBVNL	11 KV	122+275

**Part 2, Section VII-1: Employer's Requirements – General Specifications (GS)- 2x25 kV AC Traction
Electrification and associated work**

231	11 kV OH wire crossing	UHBVNL	11 KV	122+320
232	11 kV OH wire crossing	UHBVNL	11 KV	122+380
233	11 kV OH wire crossing	UHBVNL	11 KV	123+360
234	33 kV OH wire crossing	UHBVNL	33 KV	123+362
235	33 kV OH wire crossing	UHBVNL	33 KV	123+453
236	11 kV OH wire crossing	UHBVNL	11 KV	123+557

(End of Appendix-12)

APPENDIX-13: SUBCONTRACTOR FOR ROCS SYSTEM

1. Upon award of the Contract, the Contractor shall engage Specialist Sub-Contractor for Rigid Overhead Conductor System (ROCS) works. The Contractor shall submit details of Specialist Sub-Contractor proposed to be engaged for ROCS Works for the approval of the Engineer. Specialist Sub-Contractor for ROCS Works shall be engaged within six months of the Commencement Date.
2. Specialist Sub-Contractor shall have the experience of Design, Supply, Installation, Testing and Commissioning of 25 kV Rigid Overhead Conductor System (ROCS) in Railways/Metro Rail/RRTS/High Speed Rail Tunnel of minimum length of 2.0 TKM on running line in a single ongoing/completed contract during the last seven years from the last date of submission of Tender.
3. The Contractor shall submit copy of experience certificates issued by the Employer (owner of the work) as documentary evidence for meeting the minimum experience requirement for ROCS Works by the Sub-Contractor.
4. Upon approval of the Specialist Sub-Contractor by the Engineer, the Contractor shall enter into legally enforceable agreement with the Specialist Sub-Contractor within 60 days of approval of Specialist Sub-Contractor. The agreement must specify the specific role and responsibility of the Specialist Sub-Contractor.
5. The copy of the agreement between the Contractor and the Specialist Sub-Contractor shall be submitted to the Engineer.
6. Notwithstanding the approval of Subcontractor for ROCS work by Engineer, the Contractor shall be fully responsible for the ROCS work to be done by Subcontractor and Subcontractor shall have no claims against Engineer/Employer of any kind.

Note: If Contractor is meeting the experience requirement for ROCS works, the Contractor may execute the work after obtaining approval of the Engineer. The Contractor shall submit copy of experience certificates issued by the Employer (owner of the work) as documentary evidence for meeting the minimum experience requirement for ROCS Works for approval.

(End of Appendix-13)

APPENDIX-14: CONTRACTOR'S PERSONNEL

MINIMUM ORGANISATION STRUCTURE REQUIRED & PENALTY FOR NON-DEPLOYMENT

The figures indicated in Table below are the minimum number of Contractor's Personnel required which are to be deployed as per the minimum level of supervision.

S. No.	Designation of Contractor's Personnel	Minimum no. of Contractor's Personnel required	Penalty for Non-deployment per month or part thereof per person
1.	Project Manager / (Contractor's Representative/)	As per Section III, EQC	Rs 4,00,000/-
2.	Deputy Project Manager (OHE)	1	Rs 2,00,000/-
3.	Deputy Project Manager (PSI)	As per Section III, EQC	Rs 2,00,000/-
4.	Senior Design Engineer (OHE)	As per Section III, EQC	Rs 2,50,000/-
5.	Senior Design Engineer (PSI)	1	Rs 2,50,000/-
6.	Planning Engineer	1	Rs 2,50,000/-
7.	Senior Engineer (OHE)	1	
8.	Senior Engineer (ROCS)	1	
9.	Senior Engineer (PSI)	1	
10.	Senior SCADA Engineer	1	
11.	Engineer (OHE)	1	
12.	Engineer (PSI)	1	
13.	Senior Quality Assurance and Quality Control Expert	1	
14.	Procurement Manager	1	
15.	Safety and Health Expert	1	Rs 2,00,000/-
16.	Environmental Expert	1	
17.	RAMS Expert	1	-
18.	Surveyor	2	Rs 1,00,000/-
19.	<i>Civil Engineer</i>	1	Rs 2,00,000/-

**Part 2, Section VII-1: Employer's Requirements – General Specifications (GS)- 2x25 kV AC Traction
Electrification and associated work**

NOTES: -

- i. The Contractor shall deploy resources as per the above-mentioned table. The Contractor shall also confirm to deploy manpower over and above the minimum numbers indicated above, if the work so requires.
- ii. The performance of project personnel deployed will be evaluated periodically by the Engineer during the contract period. In case the performance of any of the Contractor's Personnel is not satisfactory, the Contractor shall replace them with good personnel immediately as per directions of the Engineer.
- iii. The personnel at Sr.No.1, must be deployed by Commencement Date. Personnel at Sr. No.2, 3, 4,5 & 6 in the above table must be deployed within 30 days of Commencement Date. Personnel at Sr. No.15,18 & 19 in the above table must be deployed within 90 days of Commencement Date. Non adherence to these provisions shall attract penalty as indicated in the table above.
- iv. The resources indicated in table above are for peak requirement. All resources need not be mobilized simultaneously for entire duration of the contract. The Contractor shall mobilize the resources as per the deployment programme approved by the Engineer.
- v. In case of non-deployment of contractor's personnel, the penalty shall be imposed as indicated above and deducted from Contractor's running / final bills. The decision of the Engineer in this regard shall be final and binding.

Part 2, Section VII-1: Employer's Requirements – General Specifications (GS)- 2x25 kV AC Traction Electrification and associated work

Minimum level of supervision, qualification & experience of Contractor's Personnel shall be as follows:

S. No.	DESIGNATION	QUALIFICATION	EXPERIENCE LEVEL
1.	Deputy Project Manager (OHE)	B. Tech in Electrical Engineering	Minimum total experience of 06 years out of which minimum 03 years in projects of 25kV OHE in Railway/DFC/ Metro/ RRTS
2.	Deputy Project Manager (PSI)	B. Tech in Electrical Engineering	Minimum total experience of 06 years out of which minimum 03 years in Traction Substation projects of Railway/DFC/ Metro/ RRTS
3.	Planning Engineer	B. Tech in Electrical Engineering with certification in Primavera software	Minimum total experience of 05 years out of which minimum 02 years in relevant field in planning of Infrastructure projects.
4.	Senior Engineer (OHE)	B. Tech /Diploma in Electrical Engineering	Minimum total experience of 03/05 years out of which minimum 02/03 years (degree/diploma) in Project of 25 kV OHE in Railway/DFC/Metro/RRTS
5.	Senior Engineer (ROCS)	B. Tech /Diploma in Electrical Engineering	Minimum total experience of 03/05 years out of which minimum 01/02 years (degree/diploma) in Project of ROCS in Railway/Metro/ DFC/RRTS.
6.	Senior Engineer (PSI)	B. Tech /Diploma in Electrical Engineering	Minimum total experience of 03/05 years out of which minimum 02/03 years (degree/diploma) in Traction Substations Project of Railway/DFC/ Metro/RRTS
7.	Senior SCADA Engineer	B. Tech /Diploma in Electrical/ Electronics/ Communication Engineering	Minimum total experience of 03/05 years out of which minimum 02/03 years (degree/diploma) in Project of Railway/Metro/ DFC/RRTS.
8.	Engineer (OHE)	B. Tech /Diploma in Electrical Engineering	Minimum total experience of 02/03 years out of which minimum 01/02 years (degree/diploma) in Project of 25 kV OHE in Railway/DFC/Metro/RRTS
9.	Engineer (PSI)	B. Tech /Diploma in Electrical Engineering	Minimum total experience of 02/03 years out of which minimum 01/02 years (degree/diploma) in Traction Substations Project of Railway/DFC/ Metro/RRTS
10.	Senior Quality Assurance and Quality Control Expert	B. Tech / Diploma in Electrical Engineering	Minimum total experience of 05/07 years out of which minimum 02/03 years in Quality Assurance and Control (Field) in Railway/Metro/ DFC/RRTS or Infrastructure Project.
11.	Procurement Manager	B. Tech in Electrical Engineering	Minimum total experience of 05 years out of which minimum 02 years in Electrification Project of Railway/DFC/ Metro/RRTS

Part 2, Section VII-1: Employer's Requirements – General Specifications (GS)- 2x25 kV AC Traction Electrification and associated work

S. No.	DESIGNATION	QUALIFICATION	EXPERIENCE LEVEL
12.	Safety and Health Expert	B. Tech / Diploma in Engineering/Science graduate with one-year full time Diploma in Industrial safety or equivalent	Minimum total Experience of 02/03 years with relevant experience of 01/02 years (degree/diploma) in infrastructure projects.
13.	Environmental Expert	B. Tech in Environmental Engineering/ Masters degree in Environmental Engineering/ Environmental Science or equivalent	Minimum total experience of 02 years out of which 01 year of experience of working on environmental aspects in Infrastructure projects.
14.	RAMS Expert	B. Tech in Electrical /Electronics & Communication Engineering	Minimum total experience of 05 years out of which minimum 02 years in RAMS field of Infrastructure projects.
15.	Surveyor	Diploma in Civil Engineering / ITI	Minimum total Experience of 01/02 years (diploma/ITI) in survey work for linear Infrastructure project
16	<i>Civil Engineer</i>	<i>B.Tech./Diploma in Civil Engineering</i>	<i>Minimum 5/7 years experience out of which 3/5 years (B.Tech./Diploma) in Infrastructure projects of Railway/ Metro/ DFC/ RRTS/ High Speed Rail.</i>

NOTE:

1. The Curriculum Vitae (CV) of concerned personnel shall be submitted to the Engineer for consideration. No person mentioned in table above shall be deployed in the project without Engineer's approval. Incomplete submission of CV shall not be considered as submission.
2. Relaxation in qualification / experience can be given by the Engineer in exceptional cases where candidates have got high level of professional competency. Decision of the Engineer in such cases shall be final and binding.

(End of Appendix-14)

APPENDIX-15: KEY DATES

The Key Dates (KD) Schedule for Package SYS-1, from Commencement Date:

Key Date	Days	Prithla to Harsana Kalan section and connectivity
KD-1	60	(a) Submission of Initial Works Programme with all activities. (b) Submission of preliminary design of OHE/ROCS; TSS, SP/SSP and SCADA.
KD-2	84	(a) Submission and approval of detailed Works Programme and OHE Sectioning Diagram incorporating comments of Engineer. (b) <i>Finalisation of LOP/CSD/ design- OHE of New Patli to Sultanpur</i> (including complete <i>Sultanpur</i> yard and SP at <i>Sultanpur</i>) and New Patli to Patli.
KD-3	180	(a) Finalisation of all simulation studies (b) Completion of all surveys, for OHE and PSI works of available formation front. Final pollution study report.
KD-4	240	(a) <i>Finalisation of LOP/CSD/ design- OHE of Manesar to New Patli</i> (b) <i>New Patli to Sultanpur</i> (including complete <i>Sultanpur</i> yard and SP at <i>Sultanpur</i>) and New Patli to Patli: completion of OHE Foundation work. (c) TSS Chandla Dungerwas and SSP Manesar, SP Sultanpur- SLD, GAD, civil design (land preparation, boundary wall, fencing), earth mat.
KD-5	270	(a) Finalisation of GTP & source of Traction transformer & Auto transformer and placement of purchase order. (b) Finalisation of GTP, ITP/QAP and sources of supply of all items of OHE. (c) <i>Manesar to New Patli: completion of OHE Foundation work.</i>
KD-6	300	(a) Finalisation of GTP, ITP/QAP and sources of supply of all items of PSI & SCADA. (b) Manesar to New Patli, <i>New Patli to Sultanpur</i> (including complete <i>Sultanpur</i> yard and SP at <i>Sultanpur</i>) and New Patli to Patli: Completion of erection work of OHE steel structures, isolators, wiring, dropper, earthing etc. (c) SP Sultanpur completion of structure erection and material erection.
KD-7	400	(a) Manesar to New Patli, <i>New Patli to Sultanpur</i> (including complete <i>Sultanpur</i> yard and SP at <i>Sultanpur</i>) and New Patli to Patli; completion of OHE adjustment, earthing and bonding, Tower wagon checking, EIG and Commissioning. (b) OHE Dhulawat to Manesar: completion of foundation and steel structures erection. (c) TSS Chandla Dungerwas and SSP Manesar: completion of land preparation, boundary wall, fencing, earth mat. (d) Finalisation of General Power Supply Diagram (GPSD) with equipment numbering.

Part 2, Section VII-1: Employer's Requirements – General Specifications (GS)- 2x25 kV AC Traction Electrification and associated work

Key Date	Days	Prithla to Harsana Kalan section and connectivity
KD-8	500	<p>(a) OHE Dhulawat to Manesar: completion of erection work isolators, wiring, drooping, earthing etc. Finalisation of cross feeder design.</p> <p>(b) TSS Chandla Dungerwas and Manesar SSP works: Control room building, equipment foundations, cable trench, water recharge pit, oil soak pit, structure erection, arrival of material at site.</p> <p>(c) SCADA material at site and erection work at OCC.</p>
KD-9	600	<p>(a) OHE Dhulawat to Manesar: Completion of all OHE works and testing and commissioning.</p> <p>(b) Finalisation of Traction Station Working Rules (TSWR).</p> <p>(c) Finalisation of design of all OHE, ROCS, TSS/SP/SSP.</p> <p>(d) TSS Chandla Dungerwas and SSP Manesar works: equipment erection, control cable laying, CRP erection, PFC erection, earthing, yard lighting and Testing and Commissioning.</p> <p>(e) SCADA erection work completion for OHE and TSS/SSP. Testing from OCC.</p>
KD-10	800	<p>(a) OHE Prithla to Dhulawat: Completion of Foundation work.</p> <p>(b) TSS Mandothi and SP Prithla, SP Badsa, SP Harsana Kalan, SP Asaudah and SSP Sohna, SSP Dhulawat, SSP Badli, & SSP Jasaur Kheri: completion of land preparation, fencing, boundary wall, control room building, water recharge pit etc.</p> <p>(c) Finalisation of GTP, ITP/QAP and sources of supply of all items of ROCS.</p>
<i>KD-11</i>	<i>975</i>	<i>Completion of ROCS (Tunnel-1) work.</i>
KD-12	1100	<p>(a) OHE New Patli to Harsana Kalan: Completion of foundation and mast erection work.</p> <p>(b) OHE Prithla to Dhulawat: Completion of Mast erection, wiring, earthing work etc.</p> <p>(c) <i>OHE Prithla to Dhulawat along with connectivities: Completion of Testing & Commissioning and EIG.</i></p> <p>(d) <i>ROCS (Tunnel 1): Testing & Commissioning and EIG.</i></p> <p>(e) TSS Mandothi and SP Prithla, SP Badsa, SP Harsana Kalan, SP Asaudah and SSP Sohna, SSP Dhulawat, SSP Badli, & SSP Jasaur Kheri: completion of foundations, structure erection, equipment erection etc.</p>
KD-13	1300	<p>(a) <i>New Patli to Harsana Kalan along with connectivities: Completion of Testing & Commissioning and EIG.</i></p> <p>(b) TSS Mandothi and SP Prithla, SP Badsa, SP Harsana Kalan, SP Asaudah and SSP Sohna, SSP Dhulawat, SSP Badli, & SSP Jasaur Kheri work: Testing & Commissioning and EIG.</p> <p>(c) Training of staff.</p>
KD-14	1500	<p>(a) ROCS (Tunnel -2) completion, Testing and Commissioning.</p> <p>(b) Integrated Testing completion from Prithla to Harsana Kalan.</p> <p>(c) Supply of spares, tools & tackles and measuring instruments including Tower Wagon.</p>

(End of Appendix-15)

Tender Document for Works

(Two-Envelope Tendering Process Without Prequalification)

Procurement of:

Contract Package SYS-1: Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km (-)2.099 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 315 TKM).

Part-2- EMPLOYER'S REQUIREMENTS SECTION-VII-2,

PARTICULAR SPECIFICATIONS (PS) 2X25KV, AC, TRACTION ELECTRIFICATION AND ASSOCIATED WORKS

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CHAPTER- 1 - INTRODUCTION AND OBJECTIVE

1.1 INTRODUCTION

- 1.1.1 Haryana Rail Infrastructure Development Corporation Limited (HRIDC) was Incorporated on 22nd August, 2017 as a Joint Venture between Government of Haryana and Ministry of Railways with equity Participation of 51% and 49% respectively. The Haryana Orbital Rail Corridor (HORC) is the project of HRIDC, from Prithla (near Palwal station of Indian Railways) to New Harsana Kalan (near Sonepat station of Indian Railways).
- 1.1.2 Haryana Orbital Rail Corridor (HORC) route will be Broad Gauge, Double Line, *with High Rise OHE (2x25 kV, AC) from Prithla station to New Harsana Kalan station* including connectivity to Indian Railway (IR) and DFC. *HORC project shall be provided with Automatic Signalling System.*
- 1.1.3 *Deleted.*
- 1.1.4 *There are 17 stations out of which 5 are Junction Stations namely Manesar, New Patli, Badsa, Mandothi, and New Harsana Kalan are proposed with proper connectivity with IR stations.*
- (i) Prithla station (HORC) with High Rise OHE *shall be* connected by *single* line with New Prithala station of DFC with High Rise OHE
 - (ii) *New Patli station (HORC) with High Rise OHE shall be connected by single line with IR Patli station with High Rise OHE.*
 - (iii) New Patli station (HORC) with High Rise OHE *shall be* connected by single line to Sultanpur station (IR) with High Rise OHE.
 - (iv) Sultanpur (IR) station with High Rise OHE *shall be* connected by single line to Badsa station with High Rise OHE.
 - (v) Mandothi station (HORC) with High Rise OHE *shall be* connected by single line with Asaudah station of IR with conventional ~~normal~~ OHE.
 - (vi) Manesar station (HORC) with High Rise OHE *shall be* connected with Maruti Suzuki India Limited (MSIL) factory siding *and* to IR Patli station *with single* line with High Rise OHE. MSIL-Patli work *for single line* is being executed by another agency.
 - (vii) The proposed double lines (HORC) will be ending at New Harsana Kalan station. Prithla - New Harsana Kalan section shall be connected by double lines with Harsana Kalan station of IR. *New Harsana Kalan station (HORC) shall be with conventional OHE and necessary gradient in OHE between Tarakpur and New Harsana Kalan stations shall be provided.*
- 1.1.5 *HORC Project has twin tunnels & a viaduct between IMT Sohna and Dhulawat stations.*
- 1.1.6 *Deleted.*
- 1.1.7 *Deleted*
- 1.1.8 The HORC entails construction of mostly double-track, High Rise 2x25 kV, 50 Hz, electrified railway *lines*. *The* Haryana Orbital Rail Corridor is planned to cater to double/*triple* stack containers. Up-gradation of transportation technology, increase in productivity and reduction in unit transportation costs as guiding principles for formulating the project.

1.2 OBJECTIVE

- 1.2.1 These specifications describe the objectives, guidelines and requirements for the design, manufacture, supply, construction, installation, testing and commissioning of High Rise 2x25kV, 50Hz, AC, Electric Traction System, Power Supply System, Overhead Equipment (OHE) & Rigid Overhead Conductor System(ROCS), Supervisory Control & Data Acquisition (SCADA) System, Single Phase 240V power supply by installing 25kV/240V auxiliary transformers *at Auto Location Huts (ALH)*, and stations including other associated works for New Prithla to New Harsana Kalan of the HORC Project. The objective of this Particular Specification (PS) is to provide a safe and reliable Electric Traction System meeting application duty requirements in conformance to relevant standards and requirements, performance benchmarks and Contractor demonstrates to the satisfaction of the Engineer/ Employer through modelling, simulation and design validation that the performance requirements are met by the designed system. Further the specifications is to use good industry practice so as to minimise the accidents, breakdowns due to workmanship/ material failure and incidents during implementation phase of the contract as well as to reduce the same when the electrified section is in use.
- 1.2.2 The objective of the Specifications to Design & Provide a system that renders a satisfactory life of 30-years. The Traction systems its components installed shall be capable of mid-life up gradation with minimum disruption and be supportable for the installation lifetime.
- 1.2.3 The objective of the Specifications is to minimize maintenance costs by design and selection of Maintenance friendly System which have high Availability, low Life Cycle Cost (LCC), higher Meantime between Failure (MTBF) and minimum Maintenance Time to Restore (MTTR).
- 1.2.4 The objective is to select a High Rise 2x25kV Electric Traction System which is easy to install and maintain in the least time possible commensurate with the project aims. To achieve this, the system may be designed on a modular approach such that a generic design is used as far as possible with variations to meet local requirements. The system may be designed in such a way that it can be pre-fabricated and pre-assembled unit and tested away from the site of installation and then delivered to site, installed and commissioned.
- 1.2.5 The objective of the specifications is to ensure that the environmental impact of the electrification and associated works are minimized.
- 1.2.6 The objective of the specifications is to minimize energy usage. The requirement is to reduce energy consumption by employing the energy efficient system design and product specification.

(End of Chapter-1)

CHAPTER- 2 - OVERVIEW OF THE PROJECT

2.1 HARYANA ORBITAL RAIL CORRIDOR

- 2.1.1 HRIDC has developed Haryana Orbital Rail Corridor (HORC) from Palwal to Sonapat in the state of Haryana, bypassing Delhi. It is envisaged that the Haryana Orbital Rail Corridor (HORC) will facilitate the diversion of goods traffic not meant for Delhi region and will help in developing multimodal hubs in National Capital Region (NCR) region of Haryana.
- 2.1.2 The trains are planned to be hauled by electric locomotives with 3-phase drives and/ or existing electric locomotives of Indian Railways employing up to 12000 HP loco for a single train of 6500T.
- 2.1.3 The Power Supply Installations, OHE and other associated equipment shall be capable of handling projected traffic as per HORC Train operation Plan.
- 2.1.4 The HORC will utilize 2X25 kV AT feeding system for HORC Project.
- 2.1.5 The flexible, regulated polygonal Overhead Equipment (OHE) shall be provided for movement of trains within MMD as per the Indian *Railway Schedule of Dimensions (IRSOD)* for *HORC project* at a maximum permissible speed of 160 kmph. In the Tunnel Rigid Overhead Conductor System (ROCS) shall be provided.
- 2.1.6 There are 17 stations in the section and details are as under:

SN	Station	Chainage (km)
1	Prithla	0.00
2	Silani	10.40
3	Sohna IMT	19.01
4	Dhulawat	32.77
5	Chandla Dungerwas	42.60
6	Panchgaon	46.29
7	Manesar	51.89
8	New Patli	58.00
9	Badsa	64.75
10	Deverkhana	71.14
11	Badli	76.83
12	Mandothi	90.45
13	New Asaudah	94.03
14	Jasaur Kheri	100.22
15	Kharkhoda	108.72
16	Tarakpur	114.20
17	New Harsana Kalan	125.13

Out of 17 stations, 5 are junction stations namely Manesar, New Patli, Badsa, Mandothi and New Harsana Kalan, 6 are crossing stations namely Prithla, IMT Sohna, Dhulawat, Badli, Kharkhoda & Tarakpur and remaining six stations are halt stations namely Silani, Chandala Dungerwas, Panchgaon, Deverkhana, New Asaudah, and Jasur Kheri.

2.2 POWER SUPPLY FOR THE HARYANA ORBITAL RAIL CORRIDOR

2.2.1 *Electric power supply at 220 kV through Transmission lines from SEB Grid Substation to TSS shall be provided.*

2.2.2 The 220 kV power supply shall be suitably stepped down at TSS as follows:

- (a) For feeding 2X25 kV AT systems for AC traction OHE, this shall be distributed between feeder wire and catenary – contact wires.
- (b) For feeding 240 V, single phase A.C. for auxiliary power supply requirements drawn from Traction OHE circuit through Auxiliary Transformer(s).

2.2.3 The 25kV/ 240V Auxiliary Transformers shall be provided for meeting the auxiliary power requirement of switching posts like SP, SSP, SS installation, Automatic Signaling System installation and stations etc. as described in relevant chapters of this Particular Specification.

2.2.4 The power supply shall be monitored and controlled through a Supervisory Control and Data Acquisition (SCADA) system.

2.3 CIVIL, BRIDGE, TUNNEL, TRACK, S&T AND ELECTRICAL WORKS

The Civil, *bridge, tunnel, track, S&T and Electrical works* have been planned to be assigned to Other Contractors. *Tentative list of Contract packages in HORC Project are hereunder:*

S. No.	Package	Name of Work
1.	C-1	<i>Priority Section - Construction of Earthwork, Bridges, Station Buildings, Retaining Walls and other miscellaneous works in connection with laying of New BG Double Railway line of HORC Project from Km 49.7 to Km 55.6 and its connectivity (new BG single line) from proposed Manesar Station of HORC to existing Patli Railway Station of IR Network.</i>
2.	T-1	<i>T-1: Laying of Track and track related works including supply of ballast, special sleepers, switches and crossings track fittings but excluding supply of Rails and line Sleepers in connection with laying of New BG Double Railway Line of HORC project from Km 32.00 to Km 61.5 and its connectivities to IR Network from Manesar to Patli Stations and New Patli to Patli & New Patli to Sultanpur Stations.</i>
3.	Br-1	<i>Fabrication, assembly & launching of 1X76.2 m span Open Web Girder (OWG) each over three lines on NH-352W (Pataudi Road) between Manesar and Patli stations including supplying & fixing of H-beam sleepers in connection with laying of New BG Double Railway Line of HORC project at Km 54.498.</i>
4.	C-23	<i>Design and Construction of Civil Works (Earthwork, Bridges, Station Buildings, Retaining Walls and other miscellaneous Works) from km 29.68 to km 49.70 & from km 55.60 to km 61.50 and its connectivities to IR network from New Patli to Patli station & New Patli to Sultanpur station including modifications/civil works at Sultanpur Station in connection with laying of New BG Double Railway line of HORC project.</i>

**Part 2, Section VII-2 : Employer's Requirements - Particular Specifications (PS)-for 2x25 kV, AC
Traction electrification and associated works**

S. No.	Package	Name of Work
5.	C-4	<p>Composite Contract package in connection with New BG Railway Line of HORC project for:</p> <p>(i) Design & Construction of Twin Tunnel using NATM and Cut & Cover method from km 24.850 to km 29.580;</p> <p>(ii) Design & Installation of Ballastless Track (excluding supply of rails) from km 24.843 to km 29.680;</p> <p>(iii) Detailed Design, Supply, Installation, Testing & Commissioning of General Electrical Services including Supply, Erection, Testing and Commissioning of 11kV HT/LT Power and Control Cable Network, GIS Substation (11/0.433) kVA, Tunnel lighting system, etc. from km 24.843 to km 29.680;</p> <p>(iv) Design & Construction of Embankment, Bridges and other miscellaneous works from km 12.00 to km 18.00.</p>
6.	C-5	<p>Composite Contract package in connection with New BG Double Railway Line of HORC project between stations Prithla and Dhulawat for:</p> <p>(i) Design & Construction of viaduct including Ballastless track between km 20.910 to km 24.85;</p> <p>(ii) Design and Construction of Civil Works (Earthwork, Bridges, Stations and Retaining Walls) from km -2.112 to km 12.00 & km 18.00 to km 21.330; and</p> <p>(iii) Design, Supply, Installation, Testing & Commissioning of General Electrical Services from km -2.112 to km 12.00 and Km 18.00 to Km 24.85;</p>
7.	C-6	<p>Design and Construction of Civil Works (Earthwork, Bridges, Station Buildings, Retaining Walls & other miscellaneous Works) and General Electrical Services works from km 61.50 to km 125.98 and its connectivities to IR network from proposed Badsa Station of HORC to Existing Sultanpur station and proposed Mandothi station to existing Asaudha Station in connection with laying of New BG Double Railway line of HORC Project.</p>
8.	SYS-1	<p>Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km (-)2.099 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 315 TKM).</p>
9.	SYS-2	<p>Design, Supply, Installation & Commissioning of Signalling & Telecom system in connection with laying of New BG Railway Double line of HORC Project from Prithla station (Ch: Km (-) 2.099 Km to existing New Harsana Kalan Junction (Ch: Km 125.98 Km) and Railway single line connectivity from New Patli Junction Station (Ch: Km 58.00) to existing Sultanpur railway station (RKM:3.22 approx.) and to Badsa Junction (Ch: Km 64.75) (RKM 3.84) and Mandothi to Asaudha including modifications in Patli, Sultanpur and Asaudha station yards.</p>

S. No.	Package	Name of Work
10.	T-2	<i>Design, Supply and laying of Track and Track related works in connection with laying of New BG Double Railway Line of HORC project from Km - 2.099 to Km 24.87, Km 29.06 to Km 32.00 and from Km 61.50 to Km 125.98 including its connectivities from proposed Badsa station of HORC to existing Sultanpur station on IR Network and proposed Mandothi station to existing Asaudha Station on IR Network.</i>
11.	MSIL* (OHE)	<i>Design, Supply, Erection, Testing & Commissioning of 25kV, 50 HZ, Single Phase, High Rise OHE System for Electrification Works including foundations, structures and all ancillary equipments for (i) Electrification of Maruti Suzuki Railway Yard” and “General Electrical works of proposed Station Building in Maruti Yard in connection with Railway Siding for Maruti Suzuki India Ltd. Manesar” and (ii) OHE modification of PATLI YARD area including provision of double line Sectioning Post (SP) with CB arrangement & SCADA Equipment at PATLI STATION and electrification of PATLI-MANESAR Single line connectivity in connection with HORC Project, in the State of Haryana.</i>

Notes:

- 1. The above list is only tentative and has been provided for giving overview of the Project to the Tenderers. However, it may undergo change in future at the sole discretion of HRIDC/HORC.*
- 2. Automatic Signalling System is proposed for HORC project*
- 3. *Patli (including)-Manesar-MSIL connectivity line OHE Works*

2.4 INTERFACE MANAGEMENT AND COORDINATION

The contractor shall maintain the required liaison and interface with other contractors for the delivery of the work as described in this specification.

(End of Chapter 2)

CHAPTER 3 - SCOPE OF WORKS

3.1 GENERAL

3.1.1 The Scope of Work under the Contract as described in this Particular Specification (PS) shall include conducting Traction system simulation study, Detailed design, supply, manufacture, construction, Installation, Testing & Commissioning including the technical support, trial runs & integrated testing. for a complete system necessary to provide Traction power supply from 220/132kV / 2x25kV Traction Power Supply System, AT feed system, High Rise Over Head contact line Equipment (OHE) & ROCS (Rigid Overhead Conductor System) complete with Supervisory Control and Data Acquisition (SCADA) system and associated works for Prithla to New Harsana Kalan section of HORC as under but not limited to:

- (1) Study the Employer's requirement, conduct Surveys/Studies, assess site requirement and prepare System's Requirement Specifications (SRS) as compiled from this PS, GS, Standards and other Contract documents.
- (2) Configure Traction system and major components, System architecture, Scheme Designs with Work Breakdown Schedules (WBS) of activities as per the Guidelines/Best practices describing the technology and range of the products with evidence on satisfactory and proven performance;
- (3) Operational & Performance requirement, traffic scenarios and assessing Traction power requirement;
- (4) Conduct Traction Simulation Study for identified train operation plan of the section to determine the sizes of Power supply and Overhead equipment.
- (5) 25 kV High Rise Rigid Over Head Conductor system (ROCS) for Twin Tunnels.
- (6) Preliminary, Detailed Designs and Drawings supported by calculations, reports, Quantity take off sheets, references and RAMS bench marks;
- (7) Preparation of requisite Technical Specifications & Schedule of Guaranteed Performance (SOGP) as required for procurement, Manufacture, supply, construction, installation, testing, trials and integrated testing & commissioning;
- (8) Assurance of System Safety, RAMS and Environmental requirement and Verification & Validation of Reliability performance;
- (9) Technical support for Execution, Supervision of work, Quality Assurance, Site Safety, Health & environment (SHE);
- (10) Interfaces with other associated sub systems such as Rolling Stock, Signalling & Train Control, Telecommunication system, Track systems, Depot, stations and Civil Infrastructure etc.,
- (11) Testing & commissioning of 2x25 kV AC Traction system and associated works.
- (12) Training of Employer's personnel;
- (13) Supply of spares, T&P and other equipment as specified for Operation & Maintenance.
- (14) Comprehensive maintenance of entire works under this PS for a period of 3 (three) years from the date of taking of works by Employer. Contractor shall develop daily, weekly, monthly, six-monthly, and yearly maintenance schedules and also for periodical overhaul. During this period, all material, tool and tackles,

consumables and manpower shall be provided by Contractor. The Maintenance shall be undertaken as per guidelines of RDSO, ACTM and Manufacturer's maintenance manuals. The various maintenance schedule i.e daily, weekly, monthly, quarterly, half yearly, yearly and periodic overhaul etc of all equipment of OHE, ROCS, TSS/SSP/SP and SCADA system along with associated works shall be submitted by Contractor for approval of Engineer. The details are in Chapter 20 of PS.

3.1.2 The scope shall include provision of any/ all necessary /additional equipment, equipment of higher capacities and higher ratings for the systems and sub-systems necessary for the complete, safe, reliable, operable and maintainable Electric traction power supply system for the HORC Project.

3.1.3 The scope of work shall include any other associated Works related to satisfactory completion of the Work as defined above and under this specification.

3.2 DESIGN BY COMPUTER SIMULATION

3.2.1 The capacities, ratings and numbers of equipment as proposed by the Contractor as a basic requirement of Design Development shall be determined and demonstrated by a proper Design Calculation & Traction Simulation Study and shall be got approved from the Engineer, The averaging period assumed for determining size of major equipment shall be as per EN: 50388 as applicable.

3.2.2 The Contractor shall examine and ensure through Computer based traction power simulations and EMC/EMI etc that the Indicative minimum capacities, ratings, quantities of equipment and locations as specified herein meet the operational requirement for Prithla to New Harsana Kalan section. Otherwise, contractor shall adopt the higher capacities, ratings and quantities as per the results of simulation study conducted by the contractor with the approval of the Engineer. The ratings, capacities etc. given in the PS are minimum only and shall be provided. If higher capacity rating equipments are required as per simulation studies, then higher capacity rating equipments shall be provided.

3.2.3 It shall be the responsibility of the contractor to assess, calculate and propose capacities, ratings, number/quantity and locations of equipment considering Normal/Possible power Failure and short circuit and stringent application duty and Operational Requirements for Prithla to New Harsana Kalan section as an essential requirement of the design development.

3.2.4 The Contractor shall undertake multi train traction power simulations for the entire Prithla—New Harsana Kalan section using a proven and fully validated computer based Multi Train Simulation Software. The simulation study shall model normal operations and extended feed Scenarios over feeding zone. The simulation study shall include as below but not limited to:

- (1) Traction Simulation Study: Traction Power Load Flow and Short Circuit study;
- (2) Short time Over load, Short Circuit Current in Normal and extended feed Scenarios over complete feeding zone;
- (3) The determination of sizes of the Power Supply Equipment, Traction Transformer(s), Autotransformer, CB, CT and Bus bar system etc. under Normal,

Emergency feed condition and fault scenarios;

- (4) The determination of sizes of all conductors / wires etc. under Normal, Emergency feed condition and fault scenarios within permissible Temperature rise limit in conductors like Contact wire, Catenary, Traction & Negative feeder, jumpers, AEW and BEC (if required);
- (5) Optimum Voltage Regulation / Voltage drop at SSP / SP or adjacent TSS, the farthest end for stringent possible scenario (N-1);
- (6) Voltage imbalance and THD imposed at Point of Common Coupling (PCC) with power supply authorities at normal rated capacity as well as extended feed scenario in full load conditions and mitigation measures thereof including sizing of mitigation equipment;
- (7) EMI/EMC study;
- (8) Induced EMF on the Signalling & Telecom and other utilities in proximity; Rail accessible and Touch Potential within safe limits under Normal & Fault Conditions including configuring earthing and bonding for the entire system (including those on adjacent structure and IR lines running parallel to HOCR alignment); determination of sizes / Intervals of interconnection between AEW & BEC (if required) and their connection to mast/earth-station and rail without any compromise in safety of public/ Railway maintenance personnel even in case of OHE Short Circuit Fault while ongoing discontinuity in rail track system due to hair crack(s) as well as discontinuity in AEW;
 - (1) Step and Touch potential rise in TSS, SSP, SP, SS and ATs including Earthing Calculations;
 - (2) Insulation Coordination Study;
- (9) Catenary-Pantograph Dynamic Interaction (CPDI) study etc.: Technical criteria for the interaction between pantograph and overhead contact line are stipulated in EN 50367 and EN 50119.
- (10) ROCS design validation by simulation study to ensure that ROCS design meet the maximum permissible speed.

3.2.5 Computer Simulation Analysis and Reporting

The contractor shall undertake a Computer Simulation Analysis for Prithla to New Harsana Kalan section for the following train operations:

1: Total Freight Traffic in the Horizon years

Financial year	Trains per day
<i>D</i>	48
<i>D+5</i>	59
<i>D+10</i>	72
<i>D+15</i>	81
<i>D+20</i>	93

D+25	108
D+30	128

D- Denotes year of Commissioning of HORC Project

2: Total passenger traffic along the project corridor

SN	Year	UP (Palwal to Harsana Kalan) per day	DN (Harsana Kalan to Palwal) per day	Total
1	2025	9	9	18
2	2027	10	10	20
3	2032	11	11	22
4	2037	12	12	24
5	2042	13	13	26
6	2047	14	14	28
7	2052	15	15	30

(A) Simulation -1

Normal feeding arrangement as defined in Clause 5.1.4 of Chapter 5 of this PS.

(B) Simulation -2

Emergency Feeding Arrangement- First Failure Condition as defined in Clause 5.1.5 of Chapter 5 of this PS.

3.2.6 Computer Simulation Analysis Output/ Results

The Contractor shall provide the Simulation Results in the form of Simulation Reports for each Computer Simulation Analysis.

3.3 SCOPE

3.3.1 The Scope of Work shall include design, supply, manufacture, construction, Installation, Testing & Commissioning of Traction power supply system, AT feed system, High Rise Over Head contact line Equipment (OHE) with ROCS in tunnel and Supervisory Control and Data Acquisition system and associated works for Prithla to New Harsana Kalan of HORC and connections to IR/DFCCIL lines as under but not limited to:

(1) Configuration of traction power supply system

Indicative General Arrangement Diagram (GAD) for Traction Power Supply System and Power Supply Installations are shown in the General Supply Diagram. The configuration of traction power supply system as required shall comprise of the following but not limited to:

- (i) Traction equipment, Traction Transformers, Auto transformers as required and Bus bars suitably designed/ capable to feed the extended feed zone as per application duty requirement;
- (ii) Control & Protection system and Circuit Breakers etc. as required to automatically isolate faulty section/ equipment;
- (iii) Traction Power Return current, Earthing & Lightning protection etc.

- (iv) Power Quality Monitoring, Controlling Devices and other equipment and provisions as described in the PS to improve power quality, and keep harmonics and voltage unbalance within the specified limits at rated Capacity or as specified in this specification;
- (v) Provision of Traction substations (TSS), Sub Sectioning Posts (SSP) and Sectioning Posts (SP), Switching Stations (SS) and ATs as described in relevant Chapters of this specification and as under:

a. Traction Substations (TSS)

Provision of 2(Two) Traction Sub Stations(TSS) for traction power supply to 2x25kV AT feeding system with double circuit 220/132 kV supply tapped for each TSS. Typical indicative TSS arrangement is enclosed in Part 2, Section VII, Volume 3. The provisions at TSSs shall include the gantry for termination of 220/132 kV Line and associated switchgears along with SCADA interface as required shall be executed by the contractor.

- b. Five (5) Sectioning Posts (SP).
- c. Five (5) Sub Sectioning Posts (SSP).
- d. Auto-transformers shall be provided at each TSS, SP and SSP (as required as per design). There shall not be provision of any spare AT at TSS, SP & SSP.

(2) Supervisory Control & Data Acquisition (SCADA)

- (a) The Integrated Operation Control Center (OCC) for Haryana Orbital Rail Corridor (Package SYS-1) has been planned at Manesar. The provision of SCADA equipment for Traction SCADA required at the OCC level for the entire the field equipment i.e RTU, Hardware interface and cable/Channel etc. shall be designed and executed from Prithila to New Harsana Kalan Section with connectivity at IR/DFCCIL under the Scope of the Contract. As described in relevant chapters of this PS, including the provisions for interlocking / interface arrangement with the SCADA system (SYS-1) Indian Railways and Power Supply Authority.
- (b) The 25 kV OHE work along with SCADA of Maruti Suzuki India Limited (MSIL) factory to Patli station of IR along with one additional SP at Patli station of IR is being undertaken by Contractor – MSIL(OHE). The OCC equipment for this line and additional SP shall be under the scope of this Package-SYS-1. Necessary interface with Northern Railway and Contractor-MSIL(OHE) shall be made by the Contractor SYS-1.
- (c) There will be connection of HORC line with IR i.e (1) from New Patli station to Sultanpur station (IR) and Sultanpur station (IR) to Badsa with SP at Sultanpur station (IR); (2) from Mandothi station to Asaudah station of IR with SP at Asaudah station (IR) and (3) New Harsana Kalan to Harsana Kalan station (IR) with SP at New Harsana Kalan station. Being boundary posts, the control and status of SCADA shall also be required at Northern Railway Remote Control Centre (RCC). The entire SCADA work shall be under the scope of Contractor – SYS-1. Necessary interface with Northern Railway (NR) for equipment provision and software upgradation at OCC/RCC (Remote Control Centre) of NR shall be done by the Contractor.

- (d) There shall be modifications in Harsana Kalan IR SSP along with SCADA and two 1x25 kV feeders from Harsana Kalan IR SSP to New Harsana Kalan OHE shall be provided. Necessary interface with Northern Railway (NR) shall be done by the Contractor for these works.
- (e) The HORC both lines at Pirthla station shall be connected to New Pirthla station of DFCCIL and Prithla SP shall be provided between Prithla station of HORC and New Prithla station of DFCCIL. Prithla SP shall be boundary post and hence, necessary interaction with DFCCIL shall be done by the Contractor-SYS-1 for control and status monitoring and equipment provision at DFCCIL OCC. The HORC line at Prithla shall be connected to DFCCIL line by single line at Prithla.
- (3) **240V, single phase, A.C. Auxiliary power Supply.**
- i. 240 V A.C. single phase, Low Voltage (LV), Auxiliary Power Supply shall be drawn from 25 kV Traction circuit through 2 nos. 100 kVA Auxiliary Transformers at TSS including all terminations and cabling.
- ii 240 V A.C. single phase, Low Voltage (LV), Auxiliary Power Supply shall be drawn from 25 kV Traction circuit through 2 nos. 25 kVA Auxiliary Transformers at all Power Supply Control Posts i.e. SPs and SSPs including all terminations and cabling.
- iii 240V AC, single phase, LV, Auxiliary Power Supply for other users from 25kV OHE Power Distribution System shall be provided for Signal & Telecom installations and Station Operations along the entire route with redundancies and Automatic Source Transfer / Automatic Change Over (ACO) system as required and as given below :
1. Signal & Telecom Equipment Room(s) along the entire route (if required);
 2. Crossing stations;
 3. LC Gate(s);
- iv At 4 junction stations i.e Manesar, New Patli, Badsa & Mandothi and *eight crossing stations i.e Prithla, Sohna IMT, Dhulawat, Badli, Kharkhoda, Tarakpur, New Harsana Kalan and Sultanpur, 2 nos. 50 kVA auxiliary transformers with ACO Panel at each station shall be provided. At other six stations (Silani, Chandla Dungerwas, Panchagaon, Deverkhana, New Asaudah and Jasur Kheri) 2 nos. 25 kVA auxiliary transformers at each station shall be provided with ACO panel. At Level Crossing (LC) Gate(s) (if any), 2 nos. 10 kVA auxiliary transformers shall be provided. The scope include provision of auxiliary transformer and its connection to OHE, LT box near auxiliary transformer, laying of copper cable from auxiliary transformer to Auto Change Over (ACO) Panel in at station or S&T installation (RDSO specification no. TI/SPC/PSI/CLS/0020 (amendment-4 or latest) and provision of ACO panel along with earthing wherever required.*
- v. The LT cable used for connection between 240 V AC supply from Auxiliary Transformer to Auto source transfer switch (ASTS) i.e ACO Panel shall be minimum 2 Core 70 sqmm copper conductor, XLPE insulated armoured cable. The total voltage from the LT source (Auxiliary

transformer LT to the farthest end use shall not exceed 5%.

(4) Execution of Cables, Cable containment system and feeder network including the following:

- a. 25 kV AC cable/ overhead connections from TSSs/ SPs/ SSPs/ SS /ATs (as required) to OHE.
- b. Return current cabling and bonding along the alignment and in yards;
- c. Auto Transformer connections to the rails;
- d. All connections for traction Rail bonding;
- e. Any other cable and Cable terminations etc.as required of appropriate ratings.

(5) 2x25kV AT Feed Overhead Equipment (OHE)

The OHE system configuration as required shall comprise of the following but not limited to:

- a. 2x25kV AT Feed Overhead Equipment (OHE) on main lines; comprising Traction & Negative Feeders, Catenary & contact wires;
- b. 1x25 kV system for loop lines and yard lines;
- c. 1x25 kV system for the connecting lines to Indian Railways upto IR meeting point as per Interface plan with IR and with DFCCIL;
- d. Aerial Earth Wire (AEW);
- e. Buried Earth Conductor (BEC, if required);
- f. Protective screen over catenary and NFW at foot over bridges (FOB) at Harsana Kalan station (if any) along with warning & danger boards with earthing.

(6) 2x25 kV Overhead Equipment (OHE) and ROCS

- (i) 2x25 kV, 50Hz, AC Electrifications with High Rise OHE system as per guidelines /Specifications/standard issued by RDSO/CORE/Railway Board.
- (ii) 2x25 kV, 50 Hz, AC Electrification with Traction High Rise Overhead Equipment for HORC Sections in tunnels, Viaduct Mast on Elevated section and Bridge Mast and Anchor on Bridge Piers.
- (iii) Modifications to existing OHE, feeder wires including dismantling of OHE, feeders, removal of Brackets, cutting mast/portal below 150 mm from ground level (including breakage of foundation below 150 mm from ground level to avoid any hindrance). removal of existing auxiliary transformer. The modifications in IR OHE shall be required Sultanpur, Asaudah and Harsana Kalan stations and all released material of these modifications shall be returned to IR.
- (iv) Modifications to existing DFCCIL OHE, feeder wires including dismantling of OHE, feeders, removal of Brackets, cutting mast/portal below 150 mm from ground level (including breakage of foundation below 150 mm from ground level to avoid any hindrance). removal of existing auxiliary transformer etc at

New Prithla (DFCCIL station) and Prithla (DFCCIL Lines). All the released material of these modifications shall be returned to DFCCIL.

- (v) High Rise 2x25 kV Rigid Over Head Conductor System (ROCS) for Tunnel, Transition arrangement of ROCS to 2x25 kV OHE at entrance and exit portion of twin tunnels.
- (7) Earthing and Bonding plans shall be prepared and implemented as required for Prithla to New Harsana Kalan section and adjacent Indian Railway tracks or any other Utilities or metallic structures in proximity belonging to other independent authorities to provide protective provisions against EMI from 25kV traction currents and to limit step and touch potentials as a result of Simulation study. The Simulation study shall include twin tunnels also. The earthing Simulation Study shall be got conducted by Contractor from a third party who have experience of at least 3 Railway/Metro/MRTS projects in last 5 years. The third party shall use generic software (shall not use their own software) and the software should have been used in at least 5 Railway/Metro/MRTS projects in last 5 years and proof of the same shall be submitted..
- (8) Protective measures to mitigate EMI/ EMC interference shall be implemented based on the results of traction simulation study and EMC/EMI study conducted by the contractor and as reviewed and accepted by The Engineer. Protective provisions would include provision of Aerial Earth Wire (AEW) mounted on masts with earth connections at regular intervals including connection at requisite intervals to Buried Earth Conductors (BEC, if required) to provide an energy efficient/low resistance return current path, minimise the impact of the interference, the induced voltage on utilities along the track and to limit the rail potential rise in conformance to relevant standards. The BEC (if required) shall be capable to handle the Return current as may be witnessed during the broken rail or Rail Maintenance without raising the touch potential beyond acceptable limit and compromise the safety of General public or Rail personnel in proximity/ touch. The rail conductor system network (comprising contact, catenary, Negative feeder, AEW, BEC (if required) and rails shall be modelled to demonstrate that the potential rise in all possible OHE/Power fault case scenarios remains lower than the permissible limit at any point as per relevant standards including step and touch potential while on going discontinuity in Rails unnoticed like hair cracks etc. and discontinuity of AEW due to failure/theft if any in two independent systems.
- (9) **Electrical safety and Clearances**
- a. Provisions for electrical safety i.e. Rubber mats, First aid boxes, Personal Protective Equipment (PPE) like, Goggles, Gloves, Helmets, eyewash kits, danger plates, fire-fighting equipment. Shock treatment Charts, Signage, caution boards, labels and notices in adequate number shall be exhibited at conspicuous locations being statutory requirement.
- b. Working and Electrical clearances more than or equal to the prescribed minimum clearances as identified in National Electric Code (NEC) or NFPA- 70 or prescribed by RDSO/CORE/IR/ACTM, whichever is higher.
- c. Insulation over catenary and Feeder wire under all the Bridges, FOBs, ROBs and Over-line structures. The Insulation level of the insulating sleeves considered, if any shall conform to EN50124-1.

- (10) All civil works or modifications required for installation of the equipment and restoring to final finishes by the contractor shall include but not limited to:
- a. Survey, ground investigation, soil resistivity, and hydrological studies of the site and consider for the design and Implementation including the sharing of the Video-graphic evidences of natural soil/ land levels with the Engineer.
 - b. Construction of Control Room Building at TSS, SSP, SP and Tower Wagon Shed etc. meeting the functional and technical requirement with required clearances and safety provisions as required. Provision of GI concealed conduits, wiring, fans, lights, air-conditioners (if required), outside lighting system.
 - c. Preparation and levelling of ground required for the work including earth filling for TSS / SSP / SP and other buildings constructed under this Contract Package and to lift the land to obtain the Finished Ground Level (FGL) within the Right of Way (ROW) for traction power installations. Earth compaction to be more than 95%.
 - d. Spreading of Gravels in the TSSs, SPs, SSPs and other places as required.
 - e. The Cable containment system and RCC trenches with modular trench covers, with metallic frame for ease of manual lifting; as approved by the Engineer.
 - f. Construction of road(s) and pavements within power supply installations suitable for movement of heavy equipment, Construction of Boundary wall/ fences, drainage and sewerage, rain water harvesting pits.
 - g. Construction of foundations for traction equipment / component and containments, Equipment mounting structures, OHE Masts, Portals and Gantries etc.

(11)

- (1) **'Mandatory Spares', special tools, testing and diagnostic equipment and measuring instruments** as described in relevant chapter shall be supplied at least 6 weeks before the revenue operation. The contractor shall also provide the List of 'Recommended Spares as prescribed by the Manufacturer' mentioning the Price of all such recommended Spares, which, if Employer wants, can procure. All kinds of Consumable materials not limited to printer cartridges, tapes and papers etc. shall be supplied by the contractor for the period up to the handing over of the work to the Employer. The spares consumed/ utilised by the Contractor during the Defect Notification Period shall be made good by the contractor.
- (2) The Electric Traction system designs shall be interfaced & coordinated with the civil infrastructure design with regards to site access control; fencing; paving; drainage; access roads; earthing system (earth resistivity); cables, under track/ through crossings, between traction power substations, Switching Stations and signalling, traction power substations and the Power Supply authority Indian Railway's Transmission Line Network.

3.3.2 Services

The Services to be performed by the Contractor shall include, but not be limited to, the following:

- (a) Ground Investigation, hydrological survey and report thereof before Preliminary Designs including identification of locations and construction of foundations for OHE equipment and for other equipment in TSS, SSP, SP, and ATs.
- (b) Preparation & implementation of Work Program and Management Plans as given in GS.
- (c) Study of Employer's Specifications & Deliverables, preparation of SRS and Verification & Validation (V&V) Criterion.
- (d) Preparation of Scheme/ Preliminary Design with Equipment layouts & Drawings, performance Parameters, Detailed design, calculations, studies and drawings.
- (e) Preparation of Technical Specifications and Schedule of Guaranteed Performance (SOGP) Particulars for system equipment,
- (f) Proposals on makes of material in required Format as prescribed with evidence on conformance for approval of the Engineer.
- (g) Procurement/ Supply, construction, system quality Assurance, installation, Inspections, testing and commissioning of the complete traction system
- (h) Organising & witnessing of Prototype and Factory Acceptance Testing as per test plan and Stand-alone tests of the Power Supply System, OHE ,ROCS and SCADA system/ subsystem/ equipment etc.;
- (i) Presentations, reviews and audit support as specified in this Specifications.
- (j) Interface management

The contractor shall develop the Electric Traction System with key interface requirements with other sub-systems requirements and deploy the competent professionals for the management of Interfaces and Integration with other systems/ contractors.

- (k) Taking possession/access of the site, execution of the work and return/handover.
- (l) Trial runs and integrated testing & commissioning with other systems like track, Signalling & Telecom and Rolling stock.
- (m) Training for Employer's personnel.
- (n) Decommissioning, removal and/or disposal of temporary works.
- (o) Obtaining statutory clearances including preparation of Documentation and submission of information asked for by statutory bodies e.g. Government of India, Ministry of Railways, Commissioner of Railway Safety, and Electrical Inspector to Govt. of India (EIG), Government of Haryana including fees, if any, to be borne by the contractor as directed by the Engineer.
- (p) EMC Management including twin tunnels.
- (q) Earthing & Bonding Management including twin tunnels.
- (r) Taking Power Blocks and Permit to Work for the execution of new work under the scope as required, including that for modification and dismantling involved.

- (s) Global Positioning System (GPS) Mapping of all the OHE masts/ portals, feeders of Entire OHE section to get X, Y & Z Coordinates for each mast location using best accuracy rendering GPS method as approved by the Engineer. The Mapping data shall be submitted by the Contractor in hard as well as in Soft copy to the Engineer for approval.
- (t) Service during Defect Notification Period;

3.3.3 Documentation

The documentation to be delivered by the Contractor shall include but not limited to the following:

- (1) Following documents, shall be prepared and got approved from the Engineer (who shall obtain consent of Employer): -
 - (a) Design Manual including Verification and Validation and Design Checklists,
 - (b) Simulation Studies & results for traction power study, and EMC/EMI including Input data & assumptions Reports, graphs and recommendation thereof along with supportive Explanatory Reports/ notes/ documents and any information required by The Engineer,
 - (c) EMC/EMI Control & Management Plan,
 - (d) Earthing and Bonding Management Plan,
 - (e) General Traction Power Supply Diagram and Sectioning Diagram
 - (f) Pollution Mapping of the section,
 - (g) Protection system scheme with relay coordination and Calculations,
 - (h) SCADA System documents,
 - (i) Interface Management Plan,
 - (j) Test Plans and reports as described in relevant chapter. Power Quality Study Report including the possible power correction methods with harmonic suppression.
 - (k) Installation Plan, Testing and commissioning plan.
 - (l) Technical Specifications for Power Supply System, OHE and SCADA System etc. to be drawn by the contractor, based on functional specifications for the items proposed to be used for the first time on Indian Railways.
 - (m) Demonstration results of Fault Simulation and Fault Localisation at locations as desired by the Engineer.
 - (n) Method statements, Work Plan, Quality assurance, Safety plans including site safety etc. as specified in GS.
- (2) Following documents shall be approved by the Employer to be submitted through the Engineer:
 - (a) Training plan;
 - (b) Operation and Maintenance plan.
- (3) The documents to be delivered by the contractor shall include but not be limited to, the following:
 - (a) **Preliminary Design Stage**

(i) Inception report including

- a. Understanding of Project, Scope of Work, mobilisation of resources/ office/ Organisation/ qualified design team/Key personnel, describe Approach & Methodology for design & execution and Concept Schemes of 2x25kV AT Feeding System, OHE, ROCS, Scheme of Power Supply, Power Supply equipment i.e. traction transformer(s), Auto transformers, ratings of the switchgear CT, PT, Protection scheme, SCADA System, OHE arrangement and conductors & their fittings etc.
- b. Initial work Program,
- c. Study of Employers' PS, GS, relevant standards, Employer's schemes/ Drawings and other contract documents and preparing System Requirement Specifications (SRS), Verification and Validation Criteria,
- d. Strategy on RAMS and EMC Compliance,
- e. Design manual describing design philosophy, Design Quality assurance, Design Verification checklists etc. planned to be adopted to deliver a safe and reliable Traction system.

(ii) Simulation Studies Results reports and calculations.

(iii) Preliminary Design

- a. Preliminary design including power supply diagram, sectioning diagram, SCADA and Traction system architecture
- b. Assessment of possible power failure scenarios, Normal and Peak current requirement under failure and Power supply configuration under such failure scenarios and the Power / peak current requirement;
- c. Calculations on Sizing of all Power Supply Equipment and conductors but not limited to :sizing of Jumpers, droppers, Cantilevers, Masts, foundations, conductor sag, Auto tensioning devices, OHE mechanical loading Calculations /Selection of OHE masts, ROCS, foundation design, feeder cables,Cable containments, Sizing of CB, CT, Bus bar and other provisions thereof;
- d. Earthing and Earth Mat calculation with Step and Touch potential at TSS, SSP, SP and AT as per IEEE80- 2013;
- e. TSS, SSP and SP Equipment layouts suitable to Land size and shape;
- f. Report on Design of protection systems including Lightning / Surge protection measures;
- g. Proposed design & calculations of Power Quality correction equipment and harmonic suppression;
- h. Electrical Clearance Study Report;
- I Documents for the items/ equipment not covered by RDSO specifications requiring Cross Acceptance.

(iv) Preliminary Design Report with Definitive Scheme design, Configuration of Electric Traction System, Power Supply installations, Equipment capacities/ Ratings, OHE/ROCS Installations, OHE Conductors & sizes, ROCS item sizes as confirmed by simulation study, Insulation Coordination study Report, Clearance study report, schemes and Arrangement Drawings, SCADA System, Strategy to Integrate with the IR Network Interface, Management Plan, Design submission Program.

(b) Detailed Design Stage

- (i) Final Design Scheme as concluded after the Preliminary design approval and observations thereon by the Engineer on Preliminary Design;
- (ii) Detailed Design Calculations of equipment and components as required;
- (iii) Evidences of the design compliance on simulation results;
- (iv) Technical Specifications (TS) to be drawn by the contractor based on functional specifications particularly for the items proposed to be used for the first time on Indian Railways. The Contractor shall use the Technical specification of RDSO where available. The TS prepared by the Contractor shall be generally in the format of RDSO Specifications;
- (v) Schedule of Guaranteed Performance (SOGP) Matrix;
- (vi) Detailed design Drawings;
- (vii) Design Reports complete with Executive summary, Methodology, Relevant standards, assumptions, Input data, Calculations, Study results and Recommendations;
- (viii) Study reports as relevant to conclude the designs;
- (ix) Detailed interface reports and Detailed interface Design/ Drawings(DID);
- (x) Hazard identification, Preliminary Hazard Analysis (PHA), Hazard Log and Mitigation documentation and Hazard operability;
- (xi) Earth Resistivity Measurement;
- (xii) Detailed EMC/EMI control & management plan;
- (xiii) Detailed Earthing and bonding plan;
- (xiv) Protective system proposed along with automatic fault locator (AFL) with its suitable algorithm to isolate the faulty section on OHE and feeder with high degree of accuracy;
- (xv) Pollution mapping for identification of polluted zones warranting use of longer Creepage path insulators. Minimum nominal creepage distance of insulators shall be 31mm/kV ;
- (xvi) System Reliability, Availability, Maintainability and Safety Assessment reports (RAMS);
- (xvii) Systems integration plan and proposed Integrated testing & commissioning;
- (xviii) Training Plan;

- (xix) Operation & Maintenance Plan;
- (xx) Equipment, conductor & fitting specifications and their Schedule of Guaranteed Technical Performance (SOGP).

(c) Construction & Installation Stage

- (i) Work Plan;
- (ii) Procurement Plan;
- (iii) "Quality Assurance and Quality Hold Points;
- (iv) Proposal on product makes with details on Makes, OEM, MTBF, MTTR, Maintenance Support in requisite format and Approval thereof on the Manufacturer/ brand, Approval of samples, first fix installation before mass use/ replicating elsewhere;
- (v) Manufacturer drawings needed for installation;
- (vi) Construction and Installation Plan;
- (vii) Prototype Test Plan;
- (viii) Type test reports for equipment or components selected;
- (ix) Factory Acceptance Test (FAT) Plan for equipment ;
- (x) FAT Programme;
- (xi) RAMS Plans;
- (xii) Layout Drawings of equipment to be installed;
- (xiii) Inter connection Drawings;
- (xiv) Site test report of equipment;
- (xv) Updated Earthing & Bonding plans ;
- (xvi) Updated EMC Control Plan and certificates;
- (xvii) Updated traction simulation model verified against testing data;
- (xviii) Site access control system at TSS, SP & SSP as per Appendix-11 of PS.

(d) As built documents

- (i) As Built Drawings;
- (i) Testing & Commissioning Reports/documents as required by the Engineer;
- (ii) All other records of Construction for PSI Installations , OHE including hidden parts;
- (iii) RAMS demonstration results;
- (iv) Operation and Maintenance (O&M) Manual of the equipment covering Installation, operation and maintenance instructions;
- (v) Other documentation as required by the Engineer.

(e) Operation and Maintenance (O&M) Manuals as specified in Chapter-17.

3.3.4 Proof Checking & Design Validation through an Independent agency as approved by the Engineer:

- (1) The Contractor shall propose experienced team of experts for Design Validation

and Proof-Checking of Power Supply Distribution system through an Independent Agency/Consulting Company. The Agency/Consulting Company should have experts certified as Chartered Engineer including list of proven software / tools of using similar designs as approved by the Engineer.

- (2) The Proof-Checking & Design Validation Agencies/ Consultant(s) appointed by contractor shall assess the Validation requirement in consultation with Engineer, and identify design parameters as desired by the Engineer.
- (3) The Proof checking & Design validation agency shall be fully responsible for utilization of accredited and proven software. The Proof checking & Design validation agency shall proof check & Validate the Design as desired by the Engineer including re-run of Validation as needed by the Engineer to assure the performance requirement. The process of deliverables of Proof-checking Agencies/ Consultant(s) shall include:
 - a. Validation and Submission of the Proof Checking & Validation report(s) to HORC on Detailed Designs related with Electric Traction system, Traction substations, Power supply & distribution system and equipment sizing as desired by The Employer / Engineer.
 - b. Interaction with The employer/ Engineer on Proof Checking & Validation results/ report(s), Demonstration of Validation tools to the Employer for appreciation of Proof Checking & Validation results, rerun of software and Clarifications thereof on the validation results to the Employer.
 - c. Review of Detailed designer's compliance on Validation results and (re) validation of the Design if any.
 - d. Endorsing the Certification on Contractor's designs & Drawings by the agency as 'Proof Checked & Validated' ascertaining adequacy, meeting application duty requirement and conformance to specification.
- (4) The Proof-checking & design Validation agency shall have a proven experience of carrying out design/ proof-checking work of at least two assignments related with 25kV or 2x25kV Railway Electrification system. The proposed agency shall be approved by the engineer.
- (5) *Simulation study shall be got done by the Contractor through separate specialised agency. Simulation study results and design shall be got validated from an independent Proof Checking & Validation Agency.*

3.3.5 Scope of the Works under lumpsum Schedule 'A'

Schedule 'A' includes all items of works necessary to complete the Works as per Employer's Requirements (except those included in Schedule 'B'). The scope of works under Schedule 'A' (140 RKM and 304 TKM) shall include Design, Supply, Manufacture, Construction, Installation, Testing & Commissioning of Traction power supply system, AT feed system, High Rise Overhead Equipment (2x25 kV, 50 Hz OHE), ROCS in tunnel, SCADA and associated works for entire section i.e. Prithla to New Harsana Kalan of HORC and connecting lines to IR/DFC. Chainages mentioned in the scope of works pertain to UP main line (i.e. line immediately adjoining KMP Expressway). Hence, corresponding chainages of DN main line may differ slightly. Broadly scope of works under Schedule 'A' is as given below:

1. Design of all works included in Schedule 'A'

2. OHE Works

2.1 HORC Main Line and HORC Station yards-

- a) 2x25 kV High Rise OHE from Prithla Ch. Km (-) 1.500 to New Harsana Kalan Ch. Km 124.300 including item b) and item c) given hereunder
- b) 2x25 kV High Rise ROCS in twin tunnels, Tunnel No. 1 and Tunnel No. 2 from Ch. Km 24.850 to Ch. Km 29.580 between IMT Sohna and Dhulawat stations.
- c) 2x25 kV High Rise OHE on viaduct from Ch. Km 20.910 to Ch. Km 24.850 between IMT Sohna and Dhulawat stations.
- d) HORC Station yards enroute (i.e. 4 junction stations namely Manesar, New Patli, Badsa and Mandothi, 6 crossing stations namely *Prithla, IMT Sohna, Dhulawat, Badli, Kharkhoda & Tarakpur and remaining six halt stations namely Silani, Chandala Dungerwas, Panchgaon, Deverkhana, New Asaudah, and Jasur Kheri*). Station loop lines will be 1x25kV.

2.2 Connecting Lines for IR- 1x25 kV OHE

- a) New Patli (Ch. Km 0.00) to Patli (Ch. Km 3.000) High Rise OHE
- b) New Patli (Ch. Km 0.00) to Sultanpur (Ch. Km 3.900) High Rise OHE
- c) Badsa (Ch. Km 0.00) to Sultanpur (Ch. Km 3.100) High Rise OHE
- d) Mandothi (Ch. Km 0.00) to Asaudah (Ch. Km 4.300).
Mandothi is with High Rise OHE and Asaudah is with normal OHE. Hence, OHE gradient shall be provided from Mandothi to Asaudah

3. TSS and all allied works- 2 Nos. (Chandla Dungerwas, Mandothi)

4. SP and all allied works – 3 Nos. (Prithla, Badsa, New Harsana Kalan)

5. SSP and all allied works – 5 Nos. (IMT Sohna, Dhulawat, Manesar, Badli, Jasaur Kheri)

6. SCADA– For all TSS, SP, SSP including SP at Sultanpur and Asaudah

- 6.1 SCADA for the entire HORC network including TSS- 2 Nos., 2x25kV SPs- 3 Nos., 2x25kV SSPs -5 Nos. and at all sixteen Main line stations of HORC & and New Harsana Kalan station.
- 6.2 SCADA system of 1x25kV SP at Sultanpur & Asaudah.
- 6.3 Motorized isolators at Sultanpur and Asaudah. *SCADA of Sultanpur station.*
- 6.4 Integration of IR SCADA with Remote Terminal Units (RTUs) for SPs at Sultanpur, Asaudah and New Harsana Kalan.
- 6.5 SCADA integration of Patli SP with OCC Manesar of HORC
- 6.6 Integration of Prithla SP with DFC SCADA.

7. LT Supply

- 7.1 Provision of LT power supply through 25kV/240V auxiliary transformers with associated LT cable upto stations, auto change over panel at stations along with all accessories to OHE at all sixteen main line stations.
- 7.2 Provision of LT power supply through 50kVA, 25kV/240V auxiliary transformers with associated LT cable upto stations, auto change over

panel at stations along with all accessories to OHE at Sultanpur and New Harsana Kalan stations.

- 8. Operating & Maintenance Manuals**
- 9. Supply of Tower Wagon, Mandatory Spares, Special Tools, testing and Diagnostic equipment and measuring instruments.**
- 10. Maintenance for 3 years as per scope given in Chapter-20 of Particular Specifications (PS).**

3.3.6 Scope of the Works under Schedule 'B'

Under this Schedule, the Contractor is required to carry out works which are not covered in Schedule 'A'. The scope of works under Schedule 'B' (5 RKM and 11 TKM) shall include Design, Supply, Manufacture, Construction, Installation, Testing & Commissioning. The specifications mentioned in this Particular Specifications shall be applicable to Schedule 'B' also. Broadly scope of works under Schedule 'B' shall be as given below:

- 1. IR Connectivity Lines**
 - 1.1 New Patli-Sultanpur**

1x25 kV High Rise OHE works from New Patli (Ch. Km 3.900) to Ch. Km 4.114
 - 1.2 Badsa-Sultanpur**

1x25 kV High Rise OHE works from Badsa (Ch. Km 3.100) to Ch. Km 4.400
 - 1.3 Modifications in OHE in existing Sultanpur Yard**
 - 1.4 Sultanpur SP**

All PSI works along with PTFE, cross feeder and along feeder suitable for double line
 - 1.5 Mandothi -Asaudah**

1x25 kV Conventional OHE works from Ch. Km 4.300 from Mandothi to Ch. Km 4.597 including modifications in existing IR Asaudah yard.

Mandothi is with High Rise OHE and Asaudah is with normal OHE. Hence, OHE gradient shall be provided on approach of Asaudah.
 - 1.6 Asaudah SP**

All PSI works along with PTFE, cross feeder and along feeder suitable for single line.
 - 1.7 New Harsana Kalan Station from Ch. Km 124.300 to Ch. Km 126.023 on existing IR Delhi-Ambala route**

1x25 kV Conventional OHE works at New Harsana Kalan station.

There shall be High Rise OHE in Tarakpur-New Harsana Kalan Section and New Harsana Kalan station shall be with Conventional OHE. Hence, gradient in OHE shall be provided on approach of New Harsana Kalan.
 - 1.8 Modifications at existing Harsana Kalan IR SSP along with SCADA and provision of two nos. 1x25 kV feeders from Harsana Kalan IR SSP to New Harsana Kalan OHE**

2. DFC Connectivity

2.1 New Prithla (DFC) to Prithla (HORC)

2x25 kV High Rise OHE works from Ch. Km (-) 2.099 (New Prithla) to Ch. Km (-) 1.500 (Prithla) with single line. New Prithla and Prithla both are having High Rise OHE.

2.2 Prithla station South SSP gantry modification

Prithla station South SSP gantry modification in cross feeder gantry involving erection of new steel structures and modification in cross feeder wires with drop jumpers.

3. Provision of LT power supply for Automatic Signalling System

Provision of LT power supply through 25 KVA, 25 KV/240 V Auxiliary transformer in entire open route and at other locations as decided by the Engineer for Automatic Signaling System. This will also include provision of connection to OHE, LT board near Auxiliary transformer with its Earthing, laying of copper cable from auxiliary transformer to ACO panel and provision of Auto Change Over (ACO) panel along with associated works.

4. Proposed Connectivity between Dhulawat-New Tauru Stations

Dhulawat station is proposed to be connected to New Tauru station of DFCCIL by single line (approx. 5 TKM) with 2x25 kV high rise OHE system. The Contractor shall be required to execute this work (if required) and payment shall be made under Schedule 'B'.

3.3.7 Deleted

3.3.8 Items of work excluded from the scope

The following items of work are not included in the scope. However, the Contractor shall provide timely inputs as necessary to the relevant other contractors/Agencies:

- (i) 220 kV transmission line network *with transmission line side insulators and conductors*. However, gantry at TSS shall be constructed by the Contractor for termination of 220kV incoming feeders with associated switchgear.
- (ii) Trees in the alignment or in TSS/SP/SSP, if any, shall be removed by the Civil Contractor. However, the Contractor shall coordinate with Civil Contractor.

(End of Chapter 3)

CHAPTER 4 – DESIGN AND FUNCTIONAL REQUIREMENTS

4.1 GENERAL

- 4.1.1 The design, supply, construction, installation, testing and commissioning of the Traction Power Supply System, SCADA system, auxiliary power supply at 240 V , High Rise OHE and ROCS shall meet the design and performance requirements within the design environments as specified.
- 4.1.2 The Contractor shall carry out all investigations necessary for the design of the Permanent Works and enable the determination of the methods of construction and the nature, extent and design of Temporary Works.
- 4.1.3 The Contractor shall study environmental factors and design the Traction Equipment to render the best performance in the environment they are subjected to as per application duty and to determine suitable methods of manufacture and installation, both for Temporary and Permanent Works. In particular the Contractor shall ensure that the dusty environment, rocky terrain and earth resistivity do not have detrimental effect on the functionality, reliability or long term maintainability of the Permanent Works.

4.2 DESIGN ENVIRONMENT

The traction power system shall be fully operable and maintainable in the following climatic and atmospheric conditions:

Ambient air temperature	(-)5°C degrees to (+)50°C
Average ambient temperature for one year	35 ° C
Maximum solar gain of metallic object under the sun	1kW / sqm.
Maximum relative humidity	100%
Annual Rainfall	Dry Arid regions and also heavy monsoon affecting regions with rainfall ranging from 1750mm to 6250mm.
Maximum number of thunderstorms days per annum	85
Maximum number of dust storm days per annum	35
Number of rainy days per annum	120
<i>Basic wind pressure</i>	<i>50 m/sec. Design Wind Force shall be calculated as per IS 875-Part 3.</i>
Creepage distance for (i) Extreme pollution condition (ii) Polluted conditions	As per IEC 60815 – 2008
Horizontal Seismic Zone	Refer IS 1893 Part 1 for earthquake mapping

4.3 FUNCTIONAL REQUIREMENT

- 4.3.1 The 2x25kV Traction Power Supply Systems on the Haryana Rail Orbital Corridor (HORC) shall ensure availability of reliable High Rise 2x25kV AT Feed (25kV AC for the yards) to the electric trains via overhead equipment and single phase, 240 V, AC supply for S & T installations along the route.

4.3.2 The Traction Power Supply System shall be monitored & controlled through a Supervisory Control and Data Acquisition (SCADA) System on the HORC.

4.4 DESIGN PHILOSOPHY AND REQUIREMENTS

4.4.1 Conformity with governing specifications and statutory requirements.

- (1) This Particular Specification (PS) shall be read in conjunction with the Conditions of Contract, the General Specifications (GS) and documents forming part of the Contract.
- (2) In the event of a conflict between the provisions of GS and this PS, the provisions of this PS shall prevail.
- (3) In addition to the codes, standards and provisions mentioned in these specifications, the codes and standards that may also be applicable are:
 - (a) Relevant Indian Standards,
 - (b) Relevant RDSO specifications & standards,
 - (c) Indian Railways AC Traction Manual (ACTM),
 - (d) Design Manual for Electric Traction,
 - (e) Indian Electricity Rules 1956 and Indian Electricity Act 2003,
 - (f) Safety Guidelines 2010 issued by CEA,
 - (g) IEC (INTERNATIONAL ELECTROTECHNICAL COMMISSION) Standards,
 - (h) EN (NORME EUROPÉENNE) European Standard,
 - (i) BS (British Standards),
 - (j) IEEE (Institution of Electrical and Electronics Engineers) Standards etc.
- (4) In case of any conflict or inconsistency between the provisions of the codes/ standards as mentioned above and provisions contained in these specifications the provisions in these specifications shall prevail. However, the approval of the Engineer shall be obtained to follow the relevant codes/ specifications. The decision of the Engineer shall be final.
- (5) The Contractor shall prepare and submit Technical Specifications (TS), which shall provide clear description of Functional & Performance requirements of each system, sub-system and equipment proposed along with Schedule of Guaranteed Performance (SOGP) matrix. The TS shall be drawn from the System Requirement Specification (SRS) as developed by the Contractor from the PS duly interpolated from the provisions in GS, contract documents and the relevant standards, The TS shall be submitted for the approval of the Engineer accompanied with the Para Number wise 'Compliance statement on SRS' along with NIL Exception statement on SRS. 'Exception statement' with Un-complied item (s) if any of SRS shall be submitted to the Engineer with mitigation measures. However, no deviation shall be permitted. The Technical Specification (TS) shall describe acceptable levels of performance for system/subsystem equipment / components within the environment condition stipulated above.
- (6) The TS prepared by the Contractor shall include System / Sub-system/ Equipment wise Schedule of Guaranteed Performance (SOGP) in tabulated format comprising of following Information but not limited to:

- a. System / sub-system /Equipment name,
 - b. Environment Condition ,
 - c. Designed temperature and De-rating if any required to the standard rating considered for highest ambient Temperature the equipment may experience,
 - d. Design life,
 - e. MTBF,
 - f. MTTR,
 - g. Schedule of Guaranteed Performances (SOGP) as applicable,
 - h. Testing & Commissioning requirements,
 - i. Mechanical & Electrical Interface with others,
 - j. Design Verification & Validation (V&V) check list,
 - k. Supply, Installation, Testing & commissioning (SITC) check list.
- (7) SOGP shall be provided by the Contractor for each major equipment which shall be got approved from the Engineer. The Contractor shall identify the Name of the vendor, Place of Manufacture, manufacturer model/ part number of each system/ equipment, which he plans to install. The Contractor shall submit a proposal of approval in the requisite format as approved by the Engineer.

4.4.2 Proven Design and Cross acceptance criteria

- (1) The Contractor shall develop the design based on this Particular Specification and good Industry Practices. The design details shall be submitted with supportive technical data/evidence of similar design and calculations to the Engineer for review and approval.
- (2) The System, including all Sub-systems and Equipment shall generally be of approved RDSO / CORE design / specifications, wherever applicable. Such items shall be procured from RDSO/CORE approved Part I sources only. If there is no Part I source then the material can be sourced from a Part II source. List of sources are available at RDSO / CORE websites. These items shall be subjected to prototype testing as per relevant Specifications. Prototype test shall be exempted if the test was carried out in last five (5) years from the date of issue of Letter of Acceptance (LOA) and report of the same is submitted otherwise fresh prototype test shall be carried out and certificate/report submitted.
- (3) The Contractor shall develop design and technical specifications for other items based on draft specifications (of RDSO) / functional requirement, if available, and prepare detailed specifications for approval of the Engineer.
- (4) Cross acceptance criteria shall be applicable on the following:
 - (i) Items not covered by RDSO/ CORE specifications and approved list.
 - (ii) Items which has not been used in any Rail system.
- (5) The cross acceptance criteria (CAC) shall fulfil the criteria as under:
 - (a) Last Three years satisfactory performance on AC Traction System from the date of issue of LOA, and
 - (b) The manufacturer should have supplied the equipment of minimum 70% rating of equipment offered. The Contractor shall furnish the details of its proven performance (certificate from the user) for such items, and
 - (c) The Manufacturer should have supplied at least 50% quantity to be used in

this contract in last seven years OR they can supply, maximum two times the quantity supplied in last seven years (one month prior to date of Bid Opening).

(d) Prototype test report/certificate for offered item is to be submitted. Fresh prototype test is to be conducted, if the same has not been carried out;

(i) In last five (5) years from the date of issue of LOA ;

(ii) Considering the environmental conditions as specified in this PS.

(e) The Manufacturer shall have to support maintenance and repair of the equipment in India and supply spares till the design life of the material in India. The contractor shall submit an undertaking in this effect from the Original Equipment Manufacturer (OEM).

(6) Any approval to the prototype tests by the Engineer in no way shall absolve the contractor of his responsibility for the equipment, under the terms of the contract.

(7) The prototype test already done shall be valid only if it was done on identical equipment (same rating), manufactured with identical components / raw material, at the same manufacturing facility and to identical Quality standards.

(8) The above CAC criteria shall not be applicable for ROCS items. For ROCS, the items proposed for deployment shall conform to International Standards and RDSO guidelines. The system proposed should be designed for speed potential mentioned in PS clause 8.2.1 and the detailed design report shall be submitted. The validation of design shall be carried by third party design certification *and the cost of the same shall be borne by the Contractor.*

4.4.3 The designs shall be evolved along the following guiding principles:

- (1) Service proven Design of same type;
- (2) Low life cycle cost;
- (3) Low maintenance cost;
- (4) Use of interchangeable, modular components;
- (5) Extensive and prominent labelling of parts, cables and wires;
- (6) Use of unique serial numbers for traceability of components;
- (7) High reliability;
- (8) High Availability;
- (9) Low energy loss;
- (10) Fail safe design;
- (11) Adequate redundancy in system;
- (12) Compliance with relevant standards;
- (13) Maintainable throughout the design life;
- (14) Compliance with all statutory regulations.
- (15) Future expandability

4.4.4. The contractor shall select a technology and equipment rendering equivalent or more life and better performance parameters as approved by the Engineer.

4.4.5 The General arrangement shall ensure that failure of one equipment / component or any

single point failure does not impact the availability / performance of the Installation / Equipment.

- 4.4.6** The Contractor shall detail the maintainability requirements, and demonstrate that system maintainability conforms to the claimed system reliability and availability performance. The Contractor shall demonstrate that maintenance errors have been considered, and, as far as practicable, the risk of maintenance induced faults is mitigated in the design.
- 4.4.7** The Contractor shall demonstrate, to the satisfaction of the Engineer, that Insulation coordination for all electrical equipment is incorporated in the design of the Traction Power, OHE and SCADA system.

4.5 DESIGN SUBMISSION REQUIREMENTS

- 4.5.1** The Contractor shall demonstrate that designs for the Contract are in accordance with Employer's Requirements as specified in this PS, GS and Conditions of contract. The Contractor shall submit to the Engineer for review, relevant design information and drawings as identified under each phase/stage. Such submissions shall incorporate the relevant Standards as applicable.
- 4.5.2** The design submission schedules and their stages are detailed in relevant chapter of General Specifications.

4.6 PHASES/STAGES OF DESIGN SUBMISSIONS

There are four (4) stage submissions covering the Design Phase/stage viz. Preliminary Design, Detailed Design, Construction/Installation Design and finally the As-Built Documents.

4.6.1 Preliminary Design

In the preliminary design phase/stage the contractor shall submit inception report, Scheme designs and system simulation reports as specified in GS and this PS.

(1) Inception Report and Traction Simulation Study Reports:

- (1) The Inception Report describing Approach/ Methodology to the design & execution of 2x25kV AT feeding System based on a study of freight systems around the world and to provide a cost effective and reliable design, Mobilization of qualified Design team, Review of Particular specifications and prepare SRS, schemes of the design, the Detailing on the Electric Traction System, Power Supply Installations, Traction Transformer(s), Auto Transformers, TSS/SSP/SP, OHE installations, Conductors & wires SCADA and RAMS and other performance obligations as described in the scope of work in the relevant chapter of this PS.
- (2) Simulation Studies shall be undertaken based on the Employer's requirements and HORC Train Operation plan. The study shall determine the capacities of various elements, components as indicated in Clause 3.3 and shall form the basis of details in the Inception Report.
- (3) The Inception Report and Simulation Study Reports along with sufficiently detailed drawings and documents shall be submitted for the purpose of review and approval of the Engineer. The approved inception report and traction simulation report shall then form the basis for the designs.
- (4) The preliminary design shall incorporate all design requirements including

standards, codes, performance requirement, design stresses and strains, electrical & mechanical properties of materials and all other documents or matters which are relevant to and govern the design. The Contractor shall furnish a Design Manual, which shall refer to all materials, codes and standards used, making clear their specific applications. The Design shall be produced so that it can be used by those involved in the preparation or review of the design of the Works as a comprehensive reference text and efficient working document.

(5) Electric Traction System design

Based on studies as detailed above, the contractor shall develop designs of the System and Sub-systems for traction power supply and distribution, finalizing ratings of the Equipment, switchgear, conductors & wires of the Traction Overhead System including Control & Protection Systems and SCADA. Safety Plan for the entire network including the work to be done for other contractors / agencies and IR for earthing and bonding, shall be drawn for approval by the Engineer. Works of Earthing & Bonding required on the adjacent Railway network of the Indian Railways of both electrified and non-electrified systems, in proximity to the Freight Corridor, against induced current from 2x25kV AT Feeding System shall be implemented as per sub clause 3.3.1(6), so as to provide a safe environment. The Preliminary and Detailed Design Report submission shall also provide details for, but not limited to, the following:

- (i) The design shall be coordinated to accommodate the requirements of adjacent sections, Signalling system. Final track-work, including drainage and service roads and any specified design requirements that those systems or facilities may dictate for the operation and management of the system.
 - (ii) The alignment of storm water drains along the track shall be coordinated with civil contractor to ensure that the alignment of the OHE structures and storm drains do not obstruct each other.
 - (iii) The OHE final design shall be engineered by the Contractor with consideration to the design criteria, specifications, codes and standards contained or referenced in the Employer's Requirements.
 - (iv) The Contractor shall develop Earthing and Bonding Plans covering all the buildings, structures and adjacent Indian Railway tracks or DFCCIL tracks or any other Utilities or metallic structures in proximity belonging to other independent authorities to provide protective provisions against EMI from 2x25kV traction currents and to limit touch potentials as a result of Simulation study so as to provide a safe environment.
 - (v) The design of OHE supports on bridges and ROCS supports in the tunnel, their earthing shall be coordinated with Civil Contractors.
- (6) In addition, the Contractor shall submit during this design stage the following:
- (i) The Design Submission Program in line with requirements of Chapter-4 of G.S. [Project Programme Requirements],

- (ii) Validation of Data including Geotechnical Investigation and Drawings provided by the Engineer and additional Surveys required to be carried out by the Contractor,
- (iii) A study of the Final Alignment Drawing for assessing the type and quantum of Traction Overhead work required and for planning the supply of materials and execution of the work within the time frame finalized in accordance with the Coordinated Events and key milestones available for access to the site of Works,
- (iv) A study of Right of Way (ROW) for adequacy of land in the station yards, approaches and the land acquired for TSS, SSP and SPs where traction installation are planned,
- (v) A proposal of the Work Areas outside e.g. proposed locations and design of Contractor's Temporary Works i.e. construction depots, plants, steel, fittings and other component stock pile areas, storage, workshops, camping areas etc. required to execute the Work according to the time frame,
- (vi) Main line, tunnel and Station Yard OHE Layout Plans and their sectioning,
- (vii) General Arrangement of equipment at Traction Power Supply and Control Posts,
- (viii) OHE joining with DFCCIL and IR system and slewing plan of OHE for Indian Railways' adjoining tracks infringing location of Masts, if any and Connection with OHE of adjoining section. Joining of High Rise OHE with normal height OHE (5.6/5.8 m contact wire height).
- (ix) Design of OHE structures on bridges (Important and Major Bridges), and viaducts and in tunnel.
- (x) Design of OHE under over- line structures such as ROBs, Rail Flyovers, through girder bridges, Foot Over bridges etc.,
- (xi) Earthing and Bonding diagram for structures, ROCS system and metal work along the track and in portion joining Indian Railways and DFCCIL.
- (xii) Submit Method Statements covering the following:
 - a. Construction methods for installation of equipment and structures at TSS, SSPs and SPs including Earth mats and OHE including AEW, NFW and BEC (if required).
 - b. Construction machinery and equipment to be used for foundation work, Mast erection, Bracket erection, Wiring, adjustments etc.,
 - c. Software's to be used for design activities,
 - d. Design Reviews including Checklists.
- (xiii) Two original sets of the full edition of the publication / technical standards including Codes, manuals & Standards and other documents that the Contractor proposes to use or used for the Work.
- (xiv) Combined Services Drawings (CSD);

- (xv) The Traffic Management Plan for working of the OHE Construction/ work Train;
- (xvi) Proposed on site and off site testing arrangements for testing and quality control of input materials; and
- (xvii) Manufacture, Installation and Construction Methods;
- (xviii) Procurement Program for Manufactured Items;
- (xix) Proposal for physical progress report & basis for measuring the progress of the Work;
- (xx) List of technical documents, which Contractor proposes to prepare and submit to the Engineer for his approval;
- (xxi) RAMS specifications and studies expected during the Project to demonstrate the achievement of specified targets ;
- (xxii) SCADA study including system architecture;
- (xxiii) List and documents for the items/ equipment requiring cross acceptance criterion shall be submitted.

4.6.2 Detailed Design Stage

- (1) The detailed design of the Works shall be developed by the Contractor based on the approved Inception, approved traction simulation Report and approved Preliminary Design.
- (2) Submission during detailed Design may be divided into multiple submissions as per the Submission Program approved by the Engineer. In such a case, each submission shall include correlated and interdependent submittals so that each submittal is logically independent and consistent. The submissions at different stages shall be integrated and compiled into one package at the time when the final submission is made and the compiled documents and Drawings shall be submitted to the Engineer for issue of Notice of No Objection and will be collectively referred to as the detailed Design. Every design document shall be submitted along with the Design report, Supportive Calculations, reference standards used, drawings with legends and Quantity Take-off sheets. Sub sheet(s) shall carry the master inset with clouding the relevant portion of the drawing in the sheet(s).
- (3) The detailed Design Submission shall be a coherent and complete set of documents, properly consolidated and indexed and shall fully describe the proposed Technical Design. In particular, and where appropriate, it shall define but not limited to :
 - (a) The dimensions of all major features, structural elements and members;
 - (b) All components and their specifications;
 - (c) Location, geometry and setting-out of all main elements and feature;
 - (d) Provisions and proposals for construction interfacing with the other contractors and Interfacing parties; and
 - (e) Traffic Management for delivery of materials and execution of work.
 - (f) Submission of calculations on OHE related items as under but not limited to:
 - i. Calculation for adequacy of size of OHE structures (along with AEW and NFW) selected for all types of typical OHE locations, Critical

- locations, Fixed Terminations, ATDs, overlaps, turnouts, neutral section, sharp curves, cross feeder gantry, along feeder and other Conductor support structures
- ii. foundations
 - iii. Cantilever & Conductor sizing calculations
 - iv. Cantilever movement with temperature
 - v. Impact of temperature variation & climatic conditions
 - vi. Conductor sag calculations
 - vii. Any other calculation as per EN50119 and as required by the Engineer.
- (g) submission of calculations on Power Supply Installations as under but not limited to:
- i. Calculation for adequacy of size of Battery system,
 - ii. power supply equipment,
 - iii. Cable sizing and UPS sizing
 - iv. Overload, Short circuit, harmonics, voltage imbalance and Voltage drop, Power factor, losses
 - v. Equipment & component support structures,
 - vi. Bus bar system,
 - vii. Earthing system, step & touch potential rise
 - viii. Lightning Protection system etc.
 - ix. Any other calculation as required by the Engineer
- (4) The Contractor shall not, without the prior written consent of the Engineer:
- (a) Revise or alter the content of any document and / or Drawings in the design Contract Package – SYS-1 which have been submitted to and approved by the Engineer. The Technical design shall be developed based upon the previous submission(s) unless otherwise the Engineer approves the change in the contents. Every revision of Drawing / document shall have a unique revision number, revision date including that of the reference drawing / document referred therein for establishing the traceability.
 - (b) Reduce the periods provided for review by the Engineer of any submission of design, design data and materials as set out in the Design Submission Programme;
 - (c) Revise the sequence of submissions of design, design data and material as shown in the Design Submission Programme.

(5) Detailed Drawings and Documents

The Drawings shall be a set of Drawings which describe integral feature of the Permanent Works strictly in compliance with the Employer's Requirements including, general arrangements, and layouts of structures, all materials with associated fittings, all machinery and equipment with associated fittings and Drawings which supplement the above. The Contractor shall submit including but

not limited to the following Drawings:

(a) OHE

- (i) The OHE layout plan (LOP) of the Traction Overhead equipment on the Final Alignment Plan of main line and the yard plans, including but not limited to connection to IR and DFCCIL tracks; OHE LOP of ROCS in tunnels and its connection to flexible
- (ii) OHE profile Drawings through Over-line structures, bridges & viaducts;
- (iii) General arrangement, location plan, geometry, and setting out Drawings;
- (iv) The Cross Section Alignment Drawings at all OHE structures;
- (v) The Structural Drawings for Masts and Portals for OHE and Switchyards of Traction Supply Posts.;
- (vi) Earthing and Bonding Plans;
- (vii) OHE Sectioning Diagrams of main lines and yards;
- (viii) Details of connections with Indian Railways and adjoining DFCCIL sections including the details of sectioning and traction control switching;
- (ix) OHE Structural Steel—masts and portal structures for support of the Overhead Conductor(Head spans shall not be used except at locations where the Contractor has received written permission from the Engineer);
- (x) Small part steelwork Fabrications — galvanized small part steelwork (SPS) assemblies required to support OHE, some of which may be special structural assemblies;
- (xi) Foundation Layout of Structures and Equipment;
- (xii) Cross section drawings and SED drawings.
- (xiii) Deleted*
- (xiv) All Busbars in OHE system shall be of copper material as per relevant specifications.*
- (xv) Anti creep wire (galvanized steel wire).*

(b) Traction Power Supply System

- (i) Cross section, Elevations Drawings, General arrangement and Equipment Layout plan for of TSS, SP, SSP, ATS (if any) and other installations;
- (ii) Level & filling cross section Drawings of TSS, SP & SSP;
- (iii) Incoming/Outgoing EHV transmission lines termination Gantry at TSS;
- (iv) Gantry for 25kV AT outgoing feeder to the OHE;
- (v) Architectural Control Room layout of TSS,SP and SSP and at ATS (if any);
- (vi) Layout of Earthing system;
- (vii) Lightning Protection System at TSS, SSP, SP;
- (viii) Fencing Layout;
- (ix) Typical Equipment Layout of Control Room Building for TSS,SSP and SP;
- (x) Cable trenches layout along with cross section;
- (xi) Drainage of TSS Yard including that for Cable trenches (Control and containment of oil spills should be kept in view during design of the

transformer bay(s));

- (xii) Outdoor yard layout, Bus bar supports;
- (xiii) Outdoor yard Illumination Lay Out;
- (xiv) Clearance Drawings of outdoor equipment, bus bars and conductors;
- (xv) Cable Run Layout;
- (xvi) Combined service drawings;
- (xvii) Battery and battery charger details;
- (xviii) Connection of TSS/ SSP/ SP to Adjacent Track;
- (xix) Switch Yard Slope and Drainage Drawings;
- (xx) Soil Bearing Capacity and Soil Resistivity;

(6) Detailed Design Report

- (a) The Detailed Design report shall be of narrative type describing the detailed Design Submission including its Title, executive summary, Purpose, assumptions, Input Data, Step wise Calculations with reference of the Formula used, Reference standard with Para / clause number, Summary of output results and relationship with other submissions / reference. It shall include, a guide to all relevant technical data used and outline the design approach, standards used, design calculations & analysis particularly in respect of Traction Power Supply, OHE Components and arrangement, OHE sectioning, the protection scheme and the interlocking provided for a safe and reliable traction system. The design Report shall specify the limitations for the first failure situations as a part of the reliability study.
- (b) Structural analysis report including loading diagram and input & output files of the approved software used for the design of traction structures.
- (c) For traction Power Supply System complete design document in respect of all the systems, equipment / components viz. earthing, HT/LT panels, interlocking arrangements, cabling layout, internal wiring, conduiting and general electrification works as per Vol-5 Particular Specifications for E&M, and Associated Works.
- (d) The report shall also include design submissions, EMI Mitigation/ EMC control and earthing & bonding plans for approval by the Engineer so as to ensure appropriate execution by contractor of these safety works, the completion of which is a necessary pre-requisite for completion of the project.

4.6.3 Construction/Installation Design & Drawings

Based on the approved Detailed Designs, The Contractor shall develop the construction/ Installation designs and Construction Reference Drawings (CRD) for implementation at site as specifically required for each location.

- (1) It shall have the reference of the approved detailed design/ drawing, Method statement, safety & quality check guidelines and Special Gadgets required for the execution.
- (2) It should contain all the information as required for Detailed Interface requirements.
- (3) It should contain all the information as required for the Execution and Checking.

4.6.4 As-Built Documents

The Contractor shall produce the 'As Built drawings' for the work executed but not limited to the list of drawings identified in para 4.6.2 including the following :

- (1) Dated Records of Measurements and Records of Test results;
- (2) Dated Evidences of execution i.e.
 - a. Monthly Progress Photographs & Videos of all the activities of work executed,
 - b. Progress Photographs of hidden work before covering/concealing.
- (3) Execution Report etc.

(End of Chapter 4)

CHAPTER 5 –PERFORMANCE REQUIREMENTS FOR TRACTION POWER SUPPLY SYSTEM

5.1 GENERAL

5.1.1 Traction power supply system shall be capable of meeting the projected demand of the Train service with each TSS equipped to deal with exigencies due to outage of adjacent TSS of Prithla to Badsa Section and Badsa to New Harsana Kalan Section.

5.1.2 For the purpose of Power supply reliability, double circuit 220/132kV Power supply has been planned from Haryana Power Supply Authorities for both the Traction Sub Stations (TSSs) installing 220/132kV bays incomer CBs, Bus coupler Circuit Breakers and Transformer Circuit breakers etc.

5.1.3 The TSSs shall be equipped with main Scott connected transformer and stand by Traction Transformer with adequate spare Capacity as detailed hereunder:

- (1) TSS shall be equipped with transformers with spare / stand by Capacity and in Numbers as required along with associated switchgears. The TSS shall be able to supply full power even in case of failure of any equipment or a set of Bay Equipment or bay is out of Service or under failure/ maintenance through other Equipment / bay. In case of availability of any one incomer 220/132kV supply up to transformer terminals (while other Circuit could be in failure/ maintenance) the TSS shall be able to supply power to OHE through CRISS-CROSS redundancy even if one transformer or one equipment of any bay is failed or under maintenance or not available for use.
- (2) Both the TSSs shall be provided with one set of transformers/equipments in operation sized to continuously 100% power in extended feed scenario without any compromise in any performance parameter.
- (3) Subject to Engineer's approval, the Contractor shall be allowed to do a value addition and can make own layout arrangement within the space allocated without reduction in flexibility available in existing arrangement or any compromise in performance.

The indicative typical TSS conceptual Scheme Diagram of TSS is attached in Part-2, Section VII Volume 3: Tender Drawings.

5.1.4 Normal feeding Scenario

'Normal Feeding Scenario' is defined as 'Both TSS are supplying power up to the neutral section on both sides up to adjacent SP. As there are only 2 TSSs, so Badsa SP is the common SP of both the TSSs. The Normal Scenarios shall include 'All traction equipment in service, with TSS supplying power up to the neutral section on both sides up to adjacent SP as well as the scenario as listed below:

1. 220/132 kV Bay Normal Scenario

- (a) Both the incomers are available. 220/132 kV Bus coupler in open condition. Only one of the 220/132 kV Incomer bay is taken on load. Both the 220/132 kV incomers are independently rated to take full load of the TSS.
- (b) In case, One of the incomer supply is not available or any 220/132 kV bay equipment are under fault / maintenance, the Power supply shall be available through healthy 220/132 kV bay to connected traction Transformer bay or through remotely scada operated 220/132 kV bus coupler to other Transformer Bay.

2. Traction Transformer Bays

- (a) TSS with Main and Standby Traction transformer
- i. All the Traction Transformer(s) are healthy along with 220/132 kV HV and LV (55/2x25kV) side switchgears and protection CT.
 - ii. If one of the Traction Transformer or Transformer bay equipment is not available due to fault /maintenance, the Traction Load shall be serviced by the available standby Transformer(s) or transformer(s) Bay without any impact on train operation performance. The switching over of loads between Transformer(s) shall be resorted to, for better life of transformer(s). Employer may choose to keep other standby transformer in charged and offloaded condition for short/ long time before switching over of load in line with philosophy adopted on Indian Railways.

- 3. 55kV/2x25kV Bus bar:** Bus bar shall be sectionalised to allow feed by either of the healthy Transformer / Transformer bay(s) with Bus coupler normally closed. In case of Half Bus out of service due to maintenance / fault, the Power supply shall be routed through half of the healthy bus.

4. Feeding bays:

- (a) Each bay feeds the respective right / left side of OHE system.
- (b) In case of failure of one of the bay, other bay takes care to supply the Right / left side of the power supply control post.
- (c) Redundant capacity of all equipment of the bays shall be built in for the purpose of reliability.
- (d) The bays with Auto Transformers (ATs), shall be suitably designed to allow the availability of supply through alternate route in case of failure. The capacity of ATs shall be suitably upsized with such consideration.

5.1.5 Emergency Feeding Scenario is defined as "A failure condition as per the following details:-

- (1) The TSS could be under outage due to both the incomer feeder outage, the Transformer bay(s) outage, 55kV/ 2x25kV Bus bar faulty or all the ATs of the TSS are out. The feed is extended from the adjacent healthy TSS till to the Neutral section at SP of the Outage TSS. Feed extension requires the Bridging circuit breakers to be closed at an SP and the supply from healthy TSS is extended up to neutral section at SP of adjacent outage TSS.
- (2) And the isolation of a single Auto transformer in the section.

5.1.6 Under all emergency feeding conditions; full designed headway service shall be feasible without any loss of performance.

5.1.7 First failure conditions performance requirement – Under Failure of One TSS, the power will be extended from the adjacent TSS. Traction power supply system shall be capable of meeting the projected demand of the services with each TSS designed to deal with exigencies from one adjacent TSS going out of service to facilitate extension of feed up to Neutral section of SP of Outage TSS. Under first failure condition (N-1), full design headway/ train service shall be maintained without any loss of performance.

The contractor shall identify and describe the conditions of all Single point Failure at TSS, SSP, SP and ATs and assess & quantify the impact with requirement of Power rerouting

and the energy requirement in kWh and MVA peak load.

- (1) All the equipment shall be sized considering the single point failure at the location and one TSS failure with required safety margins (in rating) to meet the application duty requirement of the most stringent power requirement without affecting the power quality.
- (2) One TSS outage may persist continuously for a number of days until the defective equipment is replaced. The Single point Failure and TSS outage shall not use the overloading capacity of the equipment as prescribed by standards.
- (3) The Traction transformer/ Transformers shall be rated for full capacity to meet the power requirement of the extended feed scenario.

5.2 ROLLING STOCK CHARACTERISTICS AND TRAIN OPERATION DATA

5.2.1 Traction power supply for Prithla to New Harsana Kalan section of HARC shall be designed taking into consideration the rolling stock characteristics and train operation data given below in *Table 5.2.1.1*, *5.2.1.2* and *Table 5.2.2*. The Tractive effort Vs Speed Characteristic of 12000HP locomotives to be utilised on HARC shall be as included in the Part-2, Section VII -3: Tender Drawings. The following data shall be used for all normal and emergency performance requirements of traction power supply system.

Table 5.2.1.1: Rolling stock characteristics for Goods Trains**

Item	Values
Maximum permissible speed	100 km/h
Adhesion	40% Starting (Indicative)/ 30 % Continuous
Locomotive weight	Weight 180 tonnes ± 1% upgradable to 200 tonnes + 1%.
Starting Tractive effort (up to speed not less than 10 kmph)	Not less than 785 kN for 25 T axle load
Type of rolling stock	BoBo+BoBo, 8 axle Locomotive hauling BOXN and bulk wagons.
Type of Braking	Electrically controlled-pneumatic service friction brake, Electric regenerative brake for the loco
Pneumatic brake effort	7 % - 9 % of gross weight
Emergency braking distance (with pneumatic brake only)	900 m maximum for light engine from 100 Kmph to standstill on level tangent dry track
Efficiency of propulsion system	Not less than 87% at full load
Auxiliary Power requirement of Locomotive	300 kVA
<i>Design Head way between trains</i>	<i>12 min.</i>

**Ref: RDSO specifications no. RDSO/2006/EL/SPEC/0044 Rev. '13' for 12000 hp locomotive.

The Tractive effort versus speed curve is shown hereunder:

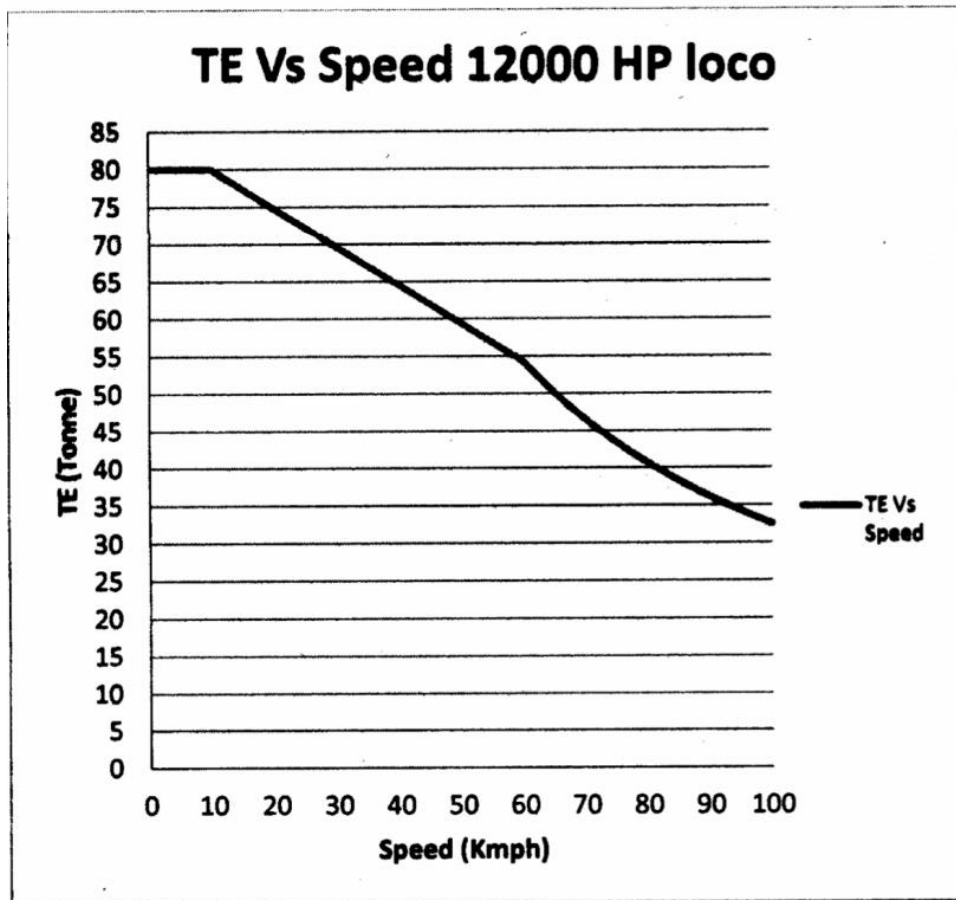
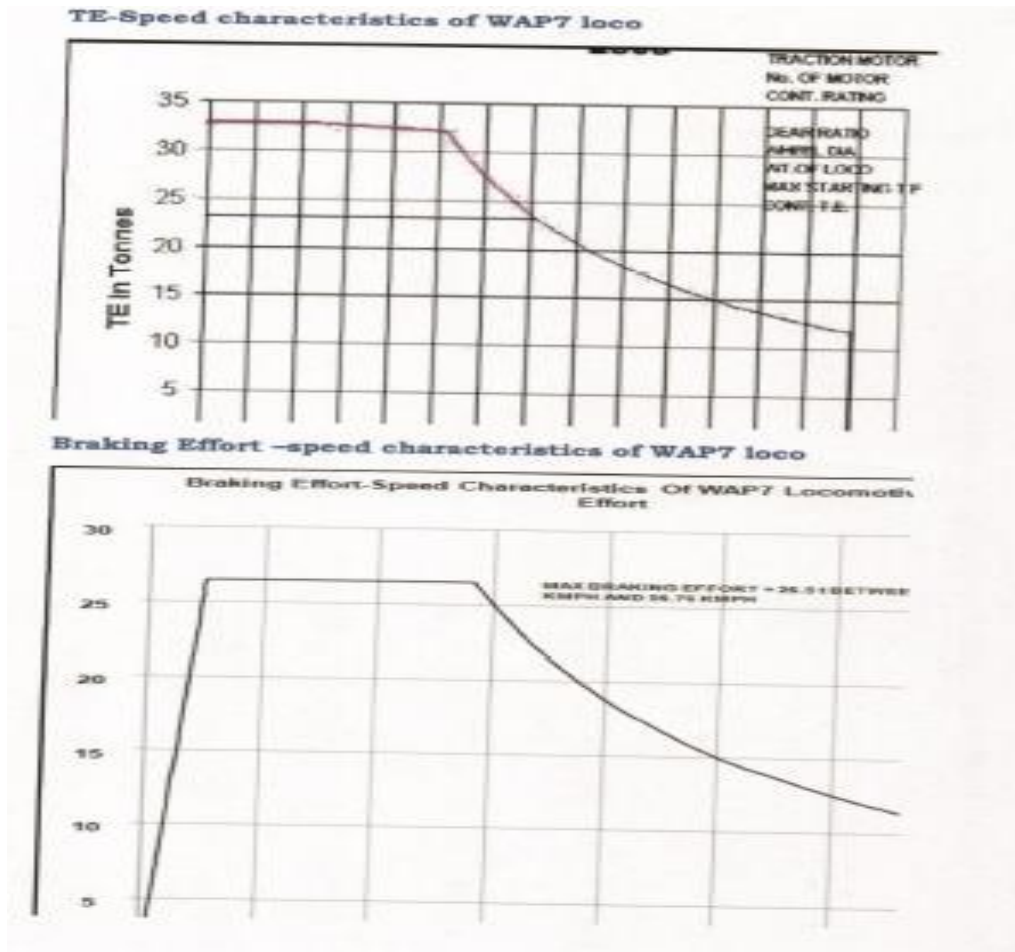


Table 5.2.1.2: Rolling stock characteristics (Passengers)***

Item	Values
Maximum permissible speed	160 kmph
Adhesion	40% Starting (Indicative)/ 30% Continuous
Locomotive weight	Weight 132 tonnes
Starting Tractive effort (up to speed not less than 10 kmph)	33 T and continuous 23.13 T for 25 T axle load.
Type of rolling stock	CO-CO, 6 axle Locomotive.
Type of Braking	Electrically controlled-pneumatic service friction brake, Electric regenerative brake for the loco
Pneumatic brake effort	7 % - 9 % of gross weight
Auxiliary Power requirement of Locomotive	300 kVA

*** RDSO Technical report for up-gradation of speed of WAP-7 locos from 140 kmph to 160 kmph
No. RDSO/2018/EL/RM/0183(Rev. 0) May, 2018

Tractive effort versus speed of WAP-7 locomotive shown here under.



- 5.2.2 These characteristics are as per RDSO Specifications and are subject to confirmation from IR. Further details such as power drawn, harmonics and various time and distance characteristics for Level of services at design headway shall be ascertained from IR.

Table 5.2.2: Train Operation plan

SN	Train Operation Plan
1	The contractor will prepare the train operation chart considering the traffic requirement of passenger and goods trains as given in clause 3.2.5 of PS.
2	The goods trains per day shall be a mix of single and double trains in the ratio of 2:1 for both UP and DN trains.
3	Train operation time shall be 20 hours and 4 hours shall be maintenance time per day.
4	For double trains – 13000 T; For single train – 6500 T.
5	Passenger trains load shall be 26 AC coaches per train.

5.3 VOLTAGE REQUIREMENTS

5.3.1 Traction power supply system for Prithla to New Harsana Kalan section of HARC shall meet the requirements given below in Table 5.3 in respect of maximum and minimum voltages at any overhead current collection point.

Table 5.3 Voltage Requirements (as per EN50163)

Item	Values
Nominal voltage	25 kV A.C.
Lowest Permanent Voltage	19 kV A.C.
Highest Permanent Voltage	27.5 kV A.C.
Lowest Non – permanent Voltage	17.5 kV A.C.
Highest Non – permanent Voltage	29 V A.C.

5.3.2 The requirement of voltage and frequency shall meet the requirements given in EN 50163.

5.4 PERFORMANCE FEATURES

The Traction Power Supply (TPS) shall be designed such that any single key components may fail without impact on the operational performance of the overall Electric Traction system. This shall be demonstrated by calculation of the load flow in case of outage of critical main components

5.5 SYSTEM REQUIREMENTS

5.5.1 Train Operations

The system shall be designed to fully satisfy the operational requirement as per the “Train Operation Plan” given in table 5.2.2.

The train resistance and locomotive resistance data as followed by IR is given below:

- (1) Train resistance (of BOX N wagon excluding Locomotive)
 - (a) Main Line starting resistance on level tangent track (including acceleration reserve) = 4.0 (in kg/tonne)
 - (b) Main Line running resistance on level tangent track = $0.6438797 + 0.01047218 V + 0.00007323 V^2$ (in kg/tonne), where V is speed in Kmph
- (2) Grade resistance = $1/G \times 1000$ (in kg/Tonne), where G is gradient (e.g. G =200 in case of 1 in 200 gradient)
- (3) Curvature resistance = $0.4 \times$ curvature in degree (in kg/tonne)
- (4) Locomotive resistance
 - (a) Starting resistance on level tangent track = 6.0 (in kg/tonne)
 - (b) Running resistance on level tangent track = $0.647 + 13.17/W + 0.00933V + 0.057/WN \times V^2$ (in kg/tonne) ,Where W = Axle load of the locomotive in tonne
N= Number of Axle, V = Speed in km/ph
- (5) The signaling system of the route shall be absolute block working type..

- (6) For failure of one TSS, the system shall be able to support 100% train service under normal and emergency feeding conditions. The regeneration figure shall be considered zero for simulation purpose. For Traction Power Simulation consider stoppage of trains at alternate stations, maximum dwell time of 5 minutes and wind speed of 0.5 m/s and Power factor of 0.95.

5.5.2 System Wide EMI Mitigation/EMC, Earthing and Bonding strategy

- (1) Based on the simulation studies, the Contractor shall develop an EMI Mitigation/ EMC strategy and Earthing & Bonding scheme for the entire system to ensure safe touch & step potentials for the traction installations and those of track and metal work of other installations of Prithla to New Harsana Kalan section of HORC. This strategy shall also include installations of other parties affected by the traction currents. The strategy shall be designed & developed for incorporating the Traction System Installations of track, bridges, viaducts, tunnel and other adjacent metallic structures, protective works for electrical circuits, signal and telecom installations and also include other parties which may be affected.
- (2) The Contractor shall ensure that step and touch potentials do not exceed the voltage limits as stipulated in EN 50122-1 during failure of Overhead equipment, snapping of conductor, Insulator leakage and locomotive fault exceeding duration of 300 ms, as minimum, subject to back up protection clearing the fault within this period to be confirmed by the contractor which, shall be demonstrated through design calculations.
- (3) The Contractor shall simulate the worst condition scenario including the failure of insulator, Rail fracture, earthing of broken conductors etc. as per EN50122-1.

(End of Chapter 5)

CHAPTER 6 – DESIGN CRITERIA & PERFORMANCE SPECIFICATIONS FOR TRACTION POWER SUPPLY SYSTEM

6.1 CONCEPTUAL POWER SUPPLY ARRANGEMENT

6.1.1 Conceptual schematic power supply arrangement diagrams of typical TSS/SSP/SP are furnished in the Part-2, Section VII Volume 3: Tender Drawings Based on the conceptual schematic Drawings, the Contractor may review, improve layouts/ arrangements to optimally utilize the space.

6.1.2 The typical TSS Power supply arrangement is planned to meet power supply for the electrification work of Pithla – New Harsana Kalan section and connecting lines to Indian Railways.

6.1.3 Traction Substations (TSSs)

- 1) The Power Supply for Prithla to New Harsana Kalan section of HORC will be brought from Grid Substation of Haryana DISCOM by 220/132 kV 3-Phase, double circuit transmission line network. TSS equipment and Bus bars shall be suitably designed and capable to feed the extended feed zone as per application duty requirement.
- 2) TSSs in the section shall be provided with equipment/ functionalities as below and as per the typical indicative schematic included in Part-2, Section VII Volume 3: Tender Drawings, but not limited to provision of:
 - (a) Incoming Bays for receiving 220/132kV double circuit power supply at TSS, the Gantry and Overhead cross feeders including terminations and insulation. Incomer bays shall have isolators and Circuit Breakers (CB) arrangement. Both the incoming bays should have facility of quick switchover of power from one 220/132 kV bay to the other 220/132 kV bay by means of 220/132kV Bus-Coupler Circuit Breaker and motorized Isolators.
 - (b) Outgoing Bays shall have provision of termination of 220/132 kV, 3-phase, double circuit power supply, the Gantry and Overhead cross feeders including terminations and insulation. Outgoing bays shall comprise motorized isolators and Circuit Breaker (CB) arrangement as required as per Indicative Arrangement included in Part 2, Section VII-3.
 - (c) Metering Bays with Check meters, Metering CT, PT and the associated insulation, protection and Monitoring arrangement, as per Utility's specifications (Power Supply Authority as case may be) with required communication ports, on the 220/132 kV incoming side in a separate cubicle at each TSS, which should have communication with OCC through SCADA.
 - (d) 220/132 kV all isolators motorized with / without earthing heels;
 - (e) 220/132 kV Bus bar arrangement;
 - (f) 220/132 kV, AC Triple pole Circuit Breakers,
 - (g) 220/132 kV – Protection Current Transformers , Potential transformers,
 - (h) 220/132 kV, AC, Triple pole Bus Coupler circuit breaker with motorized Isolator;
 - (i) 220/132/55 or 2x25kV Traction Transformer(s) complete with all accessories;

- (j) Circuit Breakers suitable for 2x25kV AT feeding System (2000 A rating minimum),
- (k) Interrupters suitable for 2x25kV AT feeding system (2000 A rating minimum),
- (l) Double pole isolators, suitable for 2X25 KV AT feeding system (2000 A rating minimum);
- (m) Lightning arrestors for 132 kV, 55kV and 2X25 KV AT feeding system as required;
- (n) 55/2x25 kV & 25kV Rigid Bus bar arrangement along with required insulation and isolation and 100% redundancy,
- (o) 25 kV Bus Coupler CBs as applicable.
- (p) Auto transformers (as required by design);
- (q) Auxiliary transformers 2 nos. 100kVA for 25kV/240V single phase supply at TSS;
- (r) Single core and multi core copper Conductor, XLPE insulated cables (for 25kV and control Cables as required) ;
- (s) Return current circuit cabling (minimum 3.3kV, single core) and bonding for the tracks in close coordination with Other Contractors/Agencies; Earthing and Bonding system including Buried Rail for efficient Traction return current;
- (t) Control & Protection system comprising of Protection relays, Control Relay panel and CTs / PTs,
- (u) Batteries and Battery Chargers (400 AH rating minimum);
- (v) Power quality improvement equipment to keep harmonics and voltage unbalance within the specified limits at rated Capacity;
- (w) Power Factor Improvement Device to improve power factor up to 0.95 or better.
- (x) Automatic Fault locator
- (y) RTU and control equipment
- (z) All civil works and general & yard lighting

6.1.4 Sub Sectioning Posts (SSP)

Sub-Sectioning Posts for 2X25 KV AT systems and as per the indicative schematic included in Part-2, Section VII Volume 3: Tender Drawings, in the section includes, but not limited to provision of:

- (1) Double pole circuit breakers for 2X25 AT system with Protection relays as required to automatically isolate fault section/ equipment (2000 A rating minimum);
- (2) Double Pole interrupters for 2X25 AT system (2000 A rating minimum);
- (3) Double pole isolators for 2X25 AT feeding system (2000 A rating minimum);
- (4) Double Pole isolators (motorised) 2x25 kV for feed extension (2000 A rating minimum);
- (5) 55 kV Auto Transformers;
- (6) Auxiliary Transformers 25 kVA, 25kV/240V, single phase;

- (7) Single core and multi core Conductor, XLPE insulated cables;
- (8) Return Current Circuit Cabling;
- (9) Earthing and bonding system;
- (10) Batteries and Chargers (*200 AH rating minimum*);
- (11) Lightning Arrestors;
- (12) Automatic Fault locator
- (13) RTU and control equipment
- (14) All Civil works and general & yard lighting.

6.1.5 Sectioning and Paralleling Posts (SP)

Sectioning and Paralleling Post for 2X25 KV AT systems and as per the indicative schematic, Part –2, Section-VII-3 includes, but not limited to provision of:

- (1) Double pole circuit breakers for 2X25 AT system with Protection relays as required to automatically isolate fault section/ equipment (*2000 A rating minimum*);
- (2) Double Pole interrupters for 2X25 AT system (*2000 A rating minimum*);
- (3) Double pole isolators, for 2X25 AT system (*2000 A rating minimum*);
- (4) 55kV Auto Transformers;
- (5) Auxiliary Transformers 25 kVA, 25kV/240V, single phase;
- (6) Single core and multi core copper Conductor, XLPE insulated cables;
- (7) Return Current Circuit Cabling;
- (8) Earthing and bonding system;
- (9) Batteries and Chargers (*200 AH rating minimum*);
- (10) Lightning Arrestors;
- (11) Automatic Fault locator
- (12) RTU and control equipments
- (13) All civil works and general & yard lighting

6.1.6 The SP at Sultanpur (for double line) and Asaudah (for single line), as approved by Engineer, shall be of 1x25 kV system and shall have following equipment but not limited to;

- (1) Single Pole interrupters for 25 kV system (*2000 A rating minimum*);
- (2) Single Pole isolators, for 25 kV system (*1600 A rating minimum*);
- (3) Double Pole isolators for 25 kV system (*1600 A rating minimum*);
- (4) Auxiliary Transformers 25 kVA, 25kV/240V, single phase;
- (5) Single core and multi core copper Conductor, XLPE insulated cables;
- (6) Return Current Circuit *75x8 mm GI flat* ;
- (7) Earthing and bonding system;
- (8) Batteries and Chargers (*40 AH rating minimum*);
- (9) Lightning Arrestors;

- (10) Earthing & and bonding Buried earth rail;
- (11) RTU and control equipment
- (12) All civil works (for double line compatibility) and general & yard lighting

6.2 DESIGN OF THE POWER SUPPLY SYSTEM

- 6.2.1 The Contractor shall propose to the Engineer a proven multi train system simulation software to be used taking into account the data for rolling stock, train loads, driving pattern speeds, stoppage, track alignment, curve and the Scheme of Electric Traction System as stipulated in clause nos. 3.2 of this specifications. The Contractor shall propose the various simulation runs to be undertaken to confirm system performance parameters and the equipment sizing, for Engineer's approval.
- 6.2.2 This Simulation study shall also be used to determine the sizes & rating of 220/132 kV, 2x25kV and 25kV Traction equipment such as Traction Transformers, Auto Transformers, circuit breakers, Interrupters, isolators, 220/132 kV Flexible and 55 & 25kV Rigid bus bar as required for TSS, SSP and SP, all traction power conductors and size of 25kV A.C. contact wire, catenary wires, ROCS conductor and feeder wire of the overhead equipment, Aerial Earth Wire (AEW) and Buried Earth Conductor (BEC, if required) taking in to account, the temperature rise in conductors, Thermo-dynamic stresses as per the application duty requirement and Emergency scenario as defined in this PS. The rating of the Auto transformers shall be same for all locations of SP/SSP and TSS as required as per design.
- 6.2.3 The Simulation software shall produce output as a minimum for the following, both during normal feed i.e. TSS in service and during extended feed i.e. one TSS out of service:-
- (1) Voltage profile at pantograph of each train simulated under normal & abnormal (N-1) conditions;
 - (2) Capacity of Traction Transformers;
 - (3) Current output of each TSS, both Peak and RMS current
 - (4) Conductor temperature rise including feeder wires;
 - (5) Load Flow study and Short Circuit study to identify the Current carrying Capacity and short circuit withstand Capacity of each circuit breaker or interrupter, Bus bars and TSS/SSP/SP equipment including current at all node points;
 - (6) Sizes of Catenary, contact wires, ROCS conductor (considering 30% worn out condition as per EN 50119), feeder wires, and jumper wires including the feeding Cables.
 - (7) Touch and step potential of Traction Rail, interval of grounding of earth wire (AEW) and Buried Earth Conductors (BEC, if required) to connect rails either directly or through impedance bonds.
 - (8) Voltage Imbalance / Fluctuation and Harmonic Distortion
 - (9) EMI/EMC study
- 6.2.4 Anticipated short circuit levels are given in Table 6.5.1. Based on the traction power system requirements and Traction power Simulation studies, the Traction power supply

system shall be designed. Sizes and ratings of all equipment, cables of different voltages 220/132 kV, 25kV A.C. and 240V A.C. auxiliary supply, earth bus and conductors, joints, jumpers, as well as ancillary equipment and instrument transformers shall be finalised. All the equipment and bus bars shall be designed to with stand the thermodynamic stresses caused by the stringent Short circuit fault scenario the system may witness. The Jumper current carrying capacity shall match with current carrying capacity of catenary and contact wires.

- 6.2.5 The details of calculations and specifications finalised shall be submitted to Engineer for approval.
- 6.2.6 The multi-train simulation study shall be used to verify the capacity of traction substations, Sectioning Posts, Sub-sectioning Posts evolve design to meet the traction power demand and voltage requirements for train operation Plan and application duty requirements satisfactorily for all power scenarios identified in relevant chapters and as under but not limited to;
- (1) Normal feed conditions and Extended feed conditions with one adjacent TSS out of Service;
 - (2) Normal Feed condition with Single point failure scenario either One source out of Service or One 220/132 kV Bay out of Service or One Main Traction Transformer / Traction Transformer Bay is out of Service or One of the 55 kV Bus bar or Half bus out of Service;
 - (3) If one line feeder breaker fails, (supply shall be routed through other bay by closing the paralleling CB/interrupter to ensure availability of power with single point failure)
 - (4) To specify the optimum interval between rails to earth connections to ensure that the rail voltages are within permissible limits as per IEC 62128/EN 50122/ EN50522.
 - (5) Max power demand in case of extended feed condition and minimum voltage at pantograph under worst condition i.e at the farthest end;
 - (6) Catenary current & temperature rise in conductor under extended feed condition, with contact wire worn out by 30%;
 - (7) Failure of Capacitor bank;
 - (8) Failure of Power quality equipment at TSS;
 - (9) One AT failure at TSS or SSP or SP;
 - (10) Extended feed conditions with one TSS out of Service with all the features as above of normal scenario;
- 6.2.7 This specification gives indicative details of power supply arrangements envisaged for traction power supply system for the Prithla to New Harsana Kalan section. The Contractor shall examine the entire scope of work and scrutinize the specified system, the specifications of cables and equipment and work out the ratings based on his own designs of the entire system without compromising the redundancy and reliability, availability and Maintainability.
- 6.2.8 Fire detection and Protection system including Fire walls and Barriers as conforming to international standards NFPA 221 and 851 at TSS, SSP and SPs shall be provided to protect against the fire risk.
- 6.2.9 Insulation level of the equipment selected shall be in conformance with EN50124-1 and IEC 60071-1 at TSS, SSP and SPs.

- 6.2.10 Automatic Fault Locators at TSS, SSP and SPs, with accuracy within ± 450 meter (3% or better inter distance between TSS-SSP, SSP-SP), shall be provided.
- 6.2.11 The Power supply system shall be monitored and controlled through a SCADA system installed at a Centralised Operation & Control Center and associated Control, monitoring & sensing equipment at TSS, SSP and SPs including the equipment level Fault Diagnostic as required.

6.3 DESIGN OF EARTH SYSTEM

- (1) System protective earthing for providing electrical safety on entire system including earthing of non-current carrying metallic components, cable supports, transformer neutrals, lightning arrestors, etc. shall be designed. The earthing system shall conform to IEEE80: 2013, EN 50122-1 and EN — 50522, IS 3043 —1987, and Earthing Manual 131 Issued by CBIP in that order of priority as applicable.
- (2) The earth system shall consist of: -
 - (a) Earth Mats and Earthing Systems in Traction Substations
 - (b) Earth Mat System in Sub-Sectioning Posts,
 - (c) Earth Mat System in Sectioning and Paralleling Posts,
 - (d) Earth Mat Systems at Auto Transformer Stations,
 - (e) Buried earth conductors (BEC, if required) of appropriate size along the track alignment as per the scheme shown in Part-2, Section VII-3: Tender Drawings,
 - (f) Isolators with earthing heels as required,
 - (g) Earth for Auxiliary Transformers,
 - (h) Buried rail and its connection,
 - (i) Earthing of Neutral section,
 - (j) Aerial Earth Wire (AEW) of appropriate size along the track alignment as per the scheme shown in Part-2, Section VII Volume 3: Tender Drawings Documents,
 - (k) OHE Structure Bond & Rail Continuity and Cross Bonding,
 - (l) Bonding and earthing, equipment earthing and working platforms to limit the step and touch potential of Equipment's working platform,
 - (m) Earthing of bridges (FOB, ROB etc.), Station Canopy, Service Building in proximity and Trackside structure in conformance to EN50122-1,
 - (n) Independent earthing/ satellite earth mat to limit the step and touchpotential.
- (3) The Contractor shall carry out design study of the earthing system on the basis of safety to public, the operator and maintenance personnel against touch and step potential & fire hazards and finalise the design, sizes and layout of main earth conductors, taking into account of adjacent 25kV system also.
- (4) In all traction power supply control posts, copper clad steel rods, GI flats and GI pipes, allowing adequate margin against corrosion shall be used as per EN-50522 / IS 3043 in that order of priority as applicable and manual on sub stations issued by Central Board of Irrigation and Power (CPIB). The earth rods below the mat shall be copper clad steel as per IEEE80/IEC62561-2/ANSI/NIMA Gr.-1-2007/EN50522-

2. All the Earth mat joints shall be exothermic as per the requirements of IEEE80:2013. The connections shall be maintenance free, self-gripping type. Wherever the earthing bonds pass along or across the tracks, it shall be routed along the sleepers using proper fasteners and clamps / exothermic joint so as to avoid damages/ disconnection during ballast screening or tie-tamping of the track.
- (5) The Earthing system provided at TSS, SSP and SP shall include Earth Mat system designed in conformance to IEEE 80: 2013. The maximum earth resistance of entire System shall meet the following requirements:

Table 6.3.1 Maximum Earth Resistance

Location	Total earth system resistance (OHMS)
TSS	0.5
SSP	2.0
SP	2.0
Auxiliary Transformer station	10.0
Other locations	To meet the requirements of EN50122-1

6.4 LIGHTNING ARRESTERS

- 6.4.1** Lightning arresters shall be installed at each location of TSS, SP, SSP, SS and ATs. All auxiliary transformers shall have provision of spark gap as per RDSO’s latest instructions.
- 6.4.2** Each lightning arrester shall incorporate an individual earth, which shall be connected to a ground rod or rods and shall also be connected to the earth system in vicinity.
- 6.4.3** Each earth connection shall have earth resistance as specified by the lightning arrester manufacturer for the type of unit supplied and shall be tested individually in accordance with testing procedures as approved by the Engineer.
- 6.4.4** Bonding cable connections between the Lightning arresters and the OHE, and between the Lightning arrester and the grounding system, shall be installed with a minimum number of bends.
- 6.4.5** The connection of lightning arresters to OHE shall be such that in case of breakage of the lightning arrester, the connector does not create an earth fault in the OHE.
- 6.4.6** Lightning arresters shall be provided with leakage current monitor and surge counters for monitoring.
- 6.4.7** In compliance to RDSO’s Maintenance Instruction No. TI/MI/0048, the Lightning Arrester shall be provided with Dis-connector assembly along with Telltale Sign so as to enable faster identification and isolation, if required, and consented by the Engineer.
- 6.4.8** Lightning Protection
- (1) The entire sub-station shall be protected against lightning strikes by providing earth screen conductors on tower peaks and/or by means of lightning protection masts suitably spaced to cover the entire area.
 - (2) The height and locations of the lightning masts shall be designed appropriately with due consideration to the equipment layout in the TSS/SSP/SP, to ensure that all the equipment required to be protected against lightning are within protective zone provided by the lightning conductor.
 - (3) The lightning conductor shall consist of ;

- (a) Lightning receiver projecting above the object to be protected;
 - (b) The earthing grid;
 - (c) The conductor which connects the receiver with the earthing grid and is meant to carry the lightning current away safely to the ground.
- (4) The contractor shall furnish a calculation for the Direct Stroke Lightning Protection system for TSS/SSP/SP and ensure that all the equipment remain protected from Direct Stroke lightning the lightning protection designs shall provide a failsafe protection to the TSS/SSP/SP building and switchyard.
- (5) Lightning protection shall conform to IEEE 998, IEC 62305 and IEC 62561 as applicable.

6.5 SHORT CIRCUIT CAPACITY

The Contractor shall ensure that traction substation and auxiliary power supply system including cables installed shall be capable of withstanding the Power Supply utilities PGCIL/DISCOM's transmission line fault levels at the points of common coupling and downstream with an allowance to cater for possible future increases. The fault levels to be catered for are given in Table-6.5.1 below:

Table 6.5.1: Design Short Circuit Levels

System Voltage kV	Fault level in kA	Fault Duration in seconds
220	40	1
132	30	1
25	12	3

Specific requirements (wherever they are different) are furnished in the equipment/sub-system specifications. The Contractor shall carryout the load flow and short circuit study of the 2x25kV distribution network and adopt the short Circuit level as stringent which may be witnessed in any stringent fault Scenario. Nevertheless the Fault level at OHE shall not be taken less than 12kA for calculations. The short circuit apparent power of the system shall be conforming to EN-60076-5 (Table-2)

6.6 EHV POWER SUPPLY DESIGN DATA

6.6.1 Insulation Coordination

- (1) The nominal voltages and corresponding maximum voltages shall be as follows:-

Nominal Voltage	Maximum Voltage
220kV	245kV
132kV	145kV
25kV	29kV
240V	250V

- (2) The 220 kV AC, 132kV AC and 240V AC equipment shall meet the Insulation coordination requirements of EN50124-1 or IS 2165 (Part I and Part II) with latest amendments as stringent.
- (3) 25kV ac equipment shall have Insulation levels according to the EN 50124, Railway Applications – Insulation co-ordination.
- (4) 2x25kV switchgears connected with out of phase power supplies of 180 Degree apart, the rated voltage will be minimum 60kV.

6.7 POWER QUALITY(PQ)

6.7.1 Contractor shall ensure the Power Quality, keeping the voltage and current unbalance, reactive power and harmonic contents, within the prescribed limit of state power utility in normal and extended feed conditions throughout the designed life of the equipment. For connectivity to the grid sub-station of power supply authorities, following power quality limits have been laid down at the point of common coupling (PCC), the contractor shall Control the Power quality within the applicable limits by providing the necessary PQ Improvement equipment. Point of Common Coupling (PCC) shall be the 220kV/132kV gantry in HORC Substation (inside the TSS boundary) where the transmission line of state power authority is terminated.

6.7.2 Voltage unbalance

The limit of voltage unbalance permitted according to Central Electricity Authority (CEA) standards are as follows:

Voltage of supply	Maximum permissible unbalance
132 kV	3%
220 kV	2%

6.7.3 Harmonics Generated at the PCC

The contractor shall carryout the Harmonic Study and Provide the Mitigation equipment to limit the Harmonics within prescribed limits as per guidelines issued by Central Electricity Authority (CEA) of India as given in table below.

Harmonics generated	132kV system	220kV system
THD for voltage	Not more than 5%	Not more than 2.5%
Any individual harmonic	Not more than 3%	Not more than 2%
THD for current	Not more than 8%	as per IEEE STD-519:1992

Note : RDSO specification for Power Quality Restorer : IS/RDSO-TI/0002 : 2023

6.7.4 Assuming an Initial demand of 30MVA, the Contractor shall install power factor correction device to improve power factor from 0.85 to 0.95 by installing 50 % static and 50 % variable capacitors or 100% Variable capacitors (without permitting to go in leading power factor) capable of up-gradation when full load of 60/84/100MVA materialises in future.

6.7.5 The design of 12000 HP locomotives is planned to limit the harmonics specified in the table below for stages of operation of 100 % down to 50% working in a train. However, for the existing locomotives on IR harmonics measurement shall be carried out for the purpose of design.

S. No.	Interference current	Limit
1	Psophometric current	10.0 A
2	DC component	4.7 A
3	Second Harmonic Component (100 Hz) and 83.33 Hz component	8.5 A
4	1400 Hz up to 5000 Hz	400mA

6.7.6 The Contractor shall prepare a detailed document on power quality and obtain prior approval of the same from Engineer.

6.8 SWITCHGEAR AND PANELS

6.8.1 All switchgear and panels shall be vermin proof, constructed from mild steel finished with powder coating by seven tank processes. The proposed colours shall be submitted for review by Engineer. Anti-condensation heaters shall be supplied where necessary. Ingress Protection Class at a minimum shall be IP 65 for outdoor installations and IP 54 for indoor installations.

6.8.2 The switchgear shall be designed motorised, draw out type such that a failed circuit breaker/ interrupter can be taken out and replaced within MTTR of 4 hour maintenance period.

6.8.3 Switchgear shall have appropriate terminations to suit the locations and electrical clearances. Where the size of available gland/ terminations is small the Contractor shall use cable box terminations to maximize the electrical clearances to the operational railway.

6.9 PROTECTION SCHEME

6.9.1 The Contractor shall define the Monitoring, control & Protection philosophy and furnish a scheme of protection with fast discrimination and reliable operation based on latest state-of-the-art computerised logic protection scheme. All types of faults on overhead equipment covering faults among conductors for 25 kV feeder, OHE, and earth shall be identified, to facilitate isolation and location (within ± 450 m accuracy) and fault locator differential protection for transformer and the distance protection with at least three zones with back up protection shall be provided for feeders. The traction switchgear and cables / feeders on supply side and the catenary on HORC side must have sufficient protection. It shall have over current protection for traction transformers with inverse definite time relays set to the rated load, earth fault protection, Buchholz relays, winding and coolant temperature detection under normal and extended feed condition.

6.9.2 The impact of trains with regeneration shall be taken by the Contractor while designing protection scheme. Definite time over-current and back up over current shall be provided. Breaker re-closing facility shall be provided and after first re-closure on the persistence of fault, breaker shall not be closed. Detailed scheme shall be put up for approval of the Engineer at design stage.

6.9.3 The scheme of protection shall be fully coordinated with the Power Supply Authorities.

6.9.4 The Contractor shall submit detailed fault calculations, relay settings and fault co-ordinated curves showing proper protection, discrimination between all upstream and downstream equipment.

6.9.5 All protection functions available in the manufacturer's specifications shall be available for use of the Employer, without having to purchase any passwords or unlocking codes. Any

such passwords or unlock codes shall be available to the Employer free of cost during or post contract.

- 6.9.6** The Contractor shall design protection system for power supply equipment to ensure:
- (1) Adequate coordination with the Power Supply Authorities/Indian Railway.
 - (2) Adequate discrimination between load and fault conditions under normal and extended feed condition.
 - (3) Adequate, required type of monitoring, control & protection system including the Protection relays, Control Relay panel and CTs / PTs etc.;
- 6.9.7** All the relays employed for the protection of the system shall be numerical type conforming to IEC – 60255 or RDSO specifications, wherever applicable
- 6.9.8** The protection scheme shall meet to the requirements of EN 60076, EN 50119, IE Rules and ACTM and include the following protections as minimum but not limited to:
- (a) 220kV/132kV Transmission Line Protection as required
 - Under Voltage
 - Over current protection instantaneous and with time delay
 - Line Distance Protection
 - (b) 220kV/132kV Bus coupler protection in TSS:
 - Backup over current protection both instantaneous and time delayed
 - Bus differential Protection
 - (c) 220kV/132kV Traction Transformer Protection
 - Over current Instantaneous / IDMT
 - Restricted Earth fault (REF)
 - Differential Protection
 - Internal faults Buchholz,
 - Oil Temperature Indicator (OTI) & Alarm (H/L) and Oil Temperature Trip (H)
 - Winding Temperature Indicator (WTI) & Alarm (H/L) and Winding temperature Trip(H),
 - Low Oil Level Alarm
 - Transformer Tank Earth Protection
 - (d) 55/ 2x25kV LV side Transformer Protection:
 - Over current Instantaneous / Inverse Definite Minimum Time (IDMT)
 - Differential Protection
 - (e) 55/ 2x25kV Bus Bar protection system
 - Under Voltage Relay
 - (f) 55/ 2x25kV Feeding Bay Breakers
 - Over current Instantaneous / IDMT
 - Distance Protection

- Under Voltage Relay
- (g) Auto Transformer Protection
 - Over current Instantaneous / IDMT
 - Restricted Earth fault (REF)
 - Differential Protection
 - Internal faults Buchholz,
 - OTI & Alarm (H/L) and Oil Temperature Trip (H)
 - WT1 & Alarm (H/L) and Winding temperature Trip(H),
 - Low Oil Level Alarm
- (h) Feeder Protection
 - Feeder Distance Protection (as applicable to SP)

6.9.9 Disturbance, event recording shall be built in feature and shall be included in the IED (Intelligent Electronic Devices), MFM (multi- function meters) including Data exchange with HMI (Human Machine Interface) and PC. The relays, IEDs, MFMs shall be provided with Suitable communication interface conforming to IEC 61850 standards.

6.10 GALVANISATION OF ALL OUTDOOR STEEL WORKS

- (1) Steel structures for outdoor TSS, SSP, SP, SS and those required for support of overhead equipment, all Small Parts Steel (SPS) works, earthing flats/pipes/rods etc shall be hot dip galvanised as per RDSO's specifications no. ETI/OHE/13 (4/84 or latest) i.e. minimum coating of zinc shall be 1000 gm/m^2 . The zinc coating specified in the equipment specification, if any, will also be considered and most stringent zinc coating out of the two will be applicable as approved by the Engineer. In case of need to use nonstandard SPS at special locations to be fixed to the steel structure, these shall be with clamps to avoid drilling of galvanized mast sections. *Galvanisation thickness at any point shall not be less than 100 micron.*
- (2) The galvanization shall be done only after cutting and drilling work is over. Galvanised bolts, nuts and spring washers shall be used for assembly work.
- (3) Wherever galvanising on ferrous components has been damaged in handling, the same shall be given two coats of zinc chromate primer and two coats of aluminium paints conforming to IS 2339 only after examination and "No Objection" from the Engineer. However, the Engineer shall reserve the right to ask any item hot dip galvanized again if he finds the galvanisation damage extensive.
- (4) All the ferrous materials used in SYS-1 works shall be galvanized.

6.11 MODULAR EQUIPMENT AND COMPONENTS

6.11.1 All components shall be modular, in construction to facilitate easy troubleshooting and replacement of components to minimize down time of the system. Design of components shall be such that it facilitates high level of interchangeability of components i.e. same size of nut bolts, number of fittings of similar type in design, shape & size as much as possible.

- 6.11.2** Equipment shall be selected from a common palette of materials to ensure that equipment is interchangeable between sites and spares & training requirement on different equipment and systems is kept to a minimum.

6.12 OUTDOOR SWITCHYARD FOR TSS

The layout shall be designed and constructed based on CBIP/RDSO guideline as applicable and other requirements specified in this PS.

6.13 ELECTROMAGNETIC COMPATIBILITY (EMC) REQUIREMENTS

6.13.1 General

The requirements stated below shall be read in conjunction with the EMC Requirements in the General Specifications.

- (1) All the Traction system equipment are expected to function satisfactorily in the environment of 220kV/132 kV, High Rise 2x25 kV, 25kV as they may be subjected to and designed to withstand all the High Voltage surges and Power variations. The Contractor shall assess and quantify the impact of EMI (Electro Magnetic Interference) and prepare an EMC Management Plan for EMI as may be witnessed in the 2x25kV environment. The EMC Plan shall also include the impact of EMI in tunnel also as 11kV/440V AC cables shall be in the tunnel for general power supply and lighting system.
- (2) An EMC Management Plan shall be submitted for review by Engineer.
- (3) The EMC Management Plan shall include measures to reduce conducted, induced, and radiated emissions, especially the levels of harmonic, to acceptable values as specified by the relevant international standards.
- (4) The plan shall analyse EMI/EMC impacts of the design of the Traction system on all other train-borne equipment and trackside equipment as well as the general environment. Particular attention shall be paid to additional requirements in grounding, bonding, and shielding, filtering, and cabling arrangements.
- (5) The Contractor shall conduct type tests as well as full EMC tests. Tests to be conducted shall include but not limited to the following standards:

(a) Overall compliance:

EN50121-1	Railway Applications Electromagnetic Compatibility – General
EN50121-2	Railway Applications Electromagnetic Compatibility – Emissions of the whole railway system to the outside World
EN50121-5	Railway Applications – Electromagnetic Compatibility - Emissions and immunity of fixed power supply installations and apparatus.
EN50152	Railways Applications — Fixed Installations — Particular requirements for ac switchgear. (All parts)

(b) Specific Standards

(i) Immunity

IEC 61000-4-2	Electrostatic discharge
IEC 61000-4-3	Radio frequency fields
IEC 61000-4-8	Power frequency magnetic field
IEC 61000-4-9	Pulse magnetic field
IEC 61000-4-10	Damped oscillatory magnetic field

(ii) Emission

IEC61000-4-6	Radiated emission
IEC61000-4-16	Conducted emission
IEC61000-2-6	Electromagnetic Compatibility Part 2: Environmental Section 6: Assessment of the emission levels in the power supply of industrial plants as regards low-frequency conducted disturbances.
IEC61000-3-2	Electromagnetic Compatibility Part 3: Limits for harmonic current emissions.
IEC61000-3-3	Electromagnetic Compatibility Part 3: Limits Section 2: Limitation of voltage fluctuations and flicker in low-voltage supply for equipment with rated current 16A.
IEC61000-3-5	Electromagnetic Compatibility Part 3: Limits Section 2: Limitation of voltage fluctuations and flicker in low-voltage supply for equipment with rated current greater than 16A.

- (6) The Contractor shall identify all EMC tests to be undertaken in the EMC Management Plan and where appropriate in the integration testing plan to demonstrate the level of EMC achieved. The test plan shall make clear the pass / fail criteria prior to any testing taking place identifying the acceptable limits, conforming standard and achieved results. All tests shall be conducted at severity levels specified by EN50121. The test plans shall be approved by the Engineer prior to any testing being undertaken.

6.13.2 Intra-system EMC

The Contractor shall ensure that all intra-system EMI are taken care of through proper design and other special measures. All major sub-systems shall be tested for emissions and immunities in accordance with the appropriate international standards for equipment operating in railway or similar industrial environment.

- (1) The Contractor shall ensure that all equipment is designed and constructed in accordance with the latest issues or versions of internationally recognized EMC standards, including but not limited to, EN50121 series and IEC61000 series to ensure proper functioning. All applicable standards shall be identified in the EMC Control Plan.
- (2) The Contractor shall also provide computations on the expected conducted and radiated emissions from the power supply system due to electrical fault, load fluctuations, and/or system imbalance. Their effects on the safety-related equipment, especially the probabilities of leading to an unsafe operation shall be determined. An appropriate document for safety audit shall be maintained by the contractor to demonstrate EMC compliance.

6.13.3 Non-safety-related systems interference

- (1) The Contractor shall take appropriate measures to ensure that EMC is achieved between the power supply equipment and all other system equipment. The transformer shall be designed with particular attention to the suppression of harmonic voltages, especially the third and fifth, or any other values as specified in the latest version of the EN 50121 series and other relevant International Standards.
- (2) All radiated emissions, either via the power cables, transformers or any other system components shall be minimised such that they conform to the appropriate international standards. Special reference shall be made to the compliance of EN50121 and IEC61000.
- (3) All power cables shall be properly shielded where applicable. Reference shall be made to IEC61000.
- (4) The Contractor shall ensure that all conducted emissions, including but not limited to harmonics, shall not interfere with telephone, communications, supervisory and control, train protection and control, and other railway equipment via the 25kV AT systems. Reference shall be made to EN50121-5 and IEC61000.
- (5) The Contractor shall also co-ordinate with other contractor/ Agencies whose equipment are connected to the power supply system and are likely to inject unwanted emissions into the power supply system to reduce such emissions. Reference shall be made to EN 50121 and IEC61000 series.

6.13.4 Environment EMC

The Contractor shall ensure that radiated emissions from the power supply cable are maintained at an internationally acceptable level. The Contractor shall also ensure that the power cables are protected from RF radiations from all telephone network operators and radio networks.

6.13.4 Installation and Mitigation Guidelines

IEC 61000-part 5 -6 series of guidelines on mitigation of external EM influences shall be observed wherever applicable.

6.13.5 Earthing

- (1) The Contractor shall prepare an Earthing & Bonding Management Plan which shall detail the approach for delivering an integrated earthing scheme covering all the systems, service buildings and DFCCIL/Indian Railways in proximity. This shall be submitted to the Engineer for approval. This plan shall apply to the Permanent Works by all the Other Contractors/ Agencies on the Project to ensure the structures and equipment are safe from EMI due to 220/132/2x25 kV traction system effects and for touch voltages and shall form an important interface requirements for the project.
- (2) Earthing system shall be designed to ensure personnel safety and protection of persons and installations against damage. It shall also serve as a common voltage reference and to contribute to the mitigation of disturbances.
- (3) The contractor shall update the Earthing and Bonding Plan to reflect any consequential changes. This plan shall be the basis of design for all earthing and bonding on Traction system, OHE and SCADA infrastructure.

6.13.6 Bonding

- (1) Bonding of all exposed metallic parts of all equipment supplied by the contractor shall be under the scope of work including connecting them to the earthing network.
- (2) Direct bonding shall be used wherever practical. Where indirect bonding via bonding strap is used to connect two isolated items, the bond shall satisfy the following minimum requirements and prevailing international standards, IEC61000 and EN 50122.
 - (a) Low bonding resistance from DC to at least 2 GHz.
 - (b) Low bonding inductance from DC to at least 2 GHz.
- (c) Proper bonding procedure, including appropriate surface treatment before and after the bonding process, is adopted.
- (d) Proper use of bond material to minimise electrolytic corrosion.

6.13.7 Cabling

- (1) The cables used shall be adequately protected against external interference. Additional protective measures, including but not limited to the use of metallic conduit, armour, screening conductors, ferrite choke, and EMI filters shall be used to reduce such external interference wherever required. Covered conduit is preferred.
- (2) A cable routing plan shall be designed to minimise likelihood of coupling between parallel cables. The Contractor shall refer to guidelines recommended by IEC61000.

Table: 6.13.9 Immunity levels at various power ports

Enclosure port	
Test	Severity level
RF field	800-1000 MHz, 20 V/m, 80%AM 1kHz
RF field – pulse modulated	900 MHz, 20 V/m, 50% duty cycle, PRF 200 Hz
Power frequency magnetic field	50 Hz, 100 A/m
Electrostatic discharge	6 kV contact, 8 kV air
RF common mode	0.15-80 MHz, 20 V, 80%AM at 1kHz source impedance 150 ohms
Fast transients	2 kV, 5/50 Tr/Th nanoseconds, PRF 5 kHz

Port for process, measurement & control lines, and long bus & control lines	
Test	Severity level
RF common mode	0.15-80 MHz, 20 V, 80%AM at 1kHz source impedance 150 ohms
Fast transients	4 kV, 5/50 Tr/Th nanoseconds, PRF 5 kHz

Transients common/diff modes	1.2/50 Tr/Th□sec, 2 kV (c), 1 kV (d)
Power frequency	150 Vrms
Power frequency common mode	650 V rms

DC input and DC output power ports	
Test	Severity level
RF common mode	0.15-80 MHz, 20 V, 80% AM at 1KHz source impedance 150 ohms
Fast transients	4kV, 5/50 Tr/Th nanoseconds, PRF 5 kHz
Transients common/diff modes	1.2/50 Tr/Th□sec, 2 kV (c), 1 kV (d)

AC input and AC output ports	
Test	Severity level
RF common mode	0.15-80 MHz, 20 V, 80%AM at 1kHz source impedance 150 ohms
Fast transients	4 kV, 5/50 Tr/Th nanoseconds, PRF 5 kHz
Transients common/diff modes	2/50 Tr/Th□sec, 2 kV (c), 1 kV (d)

Earth port	
Test	Severity level
RF common mode	0.15-80 MHz, 20 V, 80%AM at 1kHzsource impedance 150 ohms

6.13.8 Bonding of conduits & cable armour

Proper bonding & cross bonding of metallic conduits armour & screening conductor shall be made to ensure that the induced voltage in them during fault conditions are within safe limits.

(End of Chapter 6)

CHAPTER 7 – POWER SUPPLY CONTROL POSTS AND DETAILS OF EQUIPMENT

7.1 GENERAL

- 7.1.1 Traction Power Supply System Works include following installations: - Two (2) Traction Sub-Stations (TSSs); Three (3) – 2x25 kV Sectioning and Paralleling Posts (SPs); Two (2) – 1x25 kV Sectioning Posts (SPs); Seven (5) – **Sub-Sectioning Posts (SSPs)**. The Contractor shall make his own General Traction Supply Diagram based on the details of locations of TSS and traction supply posts as shown in the Part-2, Section VII Volume 3 : Tender Drawings of the Tender document.
- 7.1.2 Land has been acquired for TSSs, SSPs and SPs Power Supply Control Posts as shown in the Table 7.1.1, 7.1.2 and 7.1.3. The Contractor shall adopt the layout and design of equipment and appropriate Modular technology to reduce the footprint to accommodate TSS/SP/SSP within allocated land in the ROW maintaining the required Electrical Clearances and without compromising any performance requirement. The status of availability of land for the Supply Control Posts is as follows:
- (1) The locations of TSS have been finalized. The Contractor shall locate the Feeding overlap suitably as per the TSS location and the limitations if any due to track geometry or the STOP Signal locations.
 - (2) In regard to SSP/SPs, the required land has been identified, The Insulated overlap/Neutral Section locations may also need a review with respect to SSP/SP location and the limitations if any due to track geometry or the STOP Signal locations as stated above and accordingly manage the SSP/SP Equipment as per modular layout in the acquired land running the feeders till overlap/neutral section.
 - (3) At some locations, the provision of neutral section on the OHE opposite of the TSS and SP may not be practicable in view of these being too close to a stop signal or a restrictive aspect signal for a locomotive to permit coasting through the neutral section without the risk of being stalled. Accordingly, the neutral section will have to be suitably located away to a suitable location with feeders being run within the ROW.
 - (4) Sectioning Switches (motorized isolators) shall be provided for mainline appropriately placed, at stations to permit receiving & dispatch of the Trains and isolating the faulty section ahead and limit the length of faulty sections. The Contractor shall make his own General Supply Diagram with Sectioning Arrangement included in the Part-2, Section VII 3 : Tender Drawings of the bidding document.
- 7.1.3 In regard to SSPs, the General Power Supply diagram provides for appropriate sectioning, so as to permit trains to take alternative paths through stations during traffic and power blocks minimizing traffic delays. Table 7.1.3 indicates the tentative location of the SSPs based on Sectioning Arrangements. The Contractor should consider all these locations and prepare his own designs to provide the best sectioning of the overhead equipment for ease in maintenance and operation. Insulated Overlap (IOL) is generally, located in front of SSP. However, the location of Insulated Overlap is also based on location of STOP signals and in consideration of adequate distance, required to be located away from SSPs and may, therefore, call for running feeders for feed to OHE from SSPs.
- 7.1.4 The proposal for final designs of General Supply Diagram clearly indicating the type of Post being provided at each of the location, may be made to the Engineer for his approval.

Table 7.1.1 List of Proposed Traction Substations (TSS)

S. No	Installation Name	Approx. HORC Chainage (in Km)	Plot Size(sqm) (metre x metre) Approx.	Voltage level at point of Supply/TSS
1	Chandla Dunderwas	43.270	140 x 85	220 kV
2	Mandothi TSS	90.000	140 X 85	220 kV

***Note:**

1. Voltage level at point of supply of TSS as given above shall supersede any other values stated anywhere else in Tender Documents.

Table 7.1.2 List of Proposed Sectioning Post (SP)

S. No	Installation Name	Approx. HORC Chainage (in km)	Available Plot Size (metre x metre) Approx.	SP Type
1	Prithla SP	(-)1.00	50x30	2x25 kV
2	Badsa SP	64.750	50x30	2x25 kV
3	New Harsana Kalan SP	124.130	50x30	2x25kV
4	Sultanpur SP	13.800 (IR chainage)	22x10 (Interface with IR)	1x25 kV
5.	Asaudah SP	36 (IR chainage)	22x10 (interface with IR)	1x25 kV
6	Patli SP	48.580 (IR chainage)	Under construction by another OHE contractor (interface with IR and contractor MSIL(OHE))	1x25 kV

Table 7.1.3 List of Proposed Sub Sectioning Posts (SSP) (Mid-Section)

SN	Installation Name	Approx. HORC Chainage (in Km)	Available Plot Size (sqm) (metre x metre) approx.
1	Sohna SSP	14.570	50x30
2	Dhulawat SSP	31.770	50X30
3	Manesar SSP	52.890	50X30
4	Badli SSP	75.830	50X30
5	Jasaur Kheri SSP	101.220	50X30

- (1) The location of supply control posts shown in the tables above are based on the indicative alignment. The contractor shall prepare his own General Supply diagram based on the final Alignment Plan for the construction Designs and Drawings. The contractor shall accommodate the installations within the available land following the norms specified in relevant standards.
- (2) There is provision of insulated overlap (IOL) for main lines. The IOL's location may also require short lengths of feeder wire to be run between SSP and corresponding IOL.
- (3) Names and chainages are indicative and may change. The Same shall be confirmed through field survey while design.
- (4) The Contractor shall design the Equipment as per the feeding zone and actual location of TSS/SSP/SP.
- (5) The land area for TSS/SP/SSP is approximate and dimensions may vary. Contractor shall provide boundary wall, fencing and other civil works on the entire land handed over to the Contractor.

7.2 EXTRA HIGH VOLTAGE POWER SUPPLY TO TSS

- 7.2.1 The Contractor shall provide all requirements for EHV Line Termination at the TSS to enable the Power Supply Authorities to complete their work and release power supply.
- 7.2.2 The Point of Interface between the State Power Supply Authorities (PSA) for 220/132kV, 3-phase, double circuit transmission line and the Contractor will be at the TSS's EHV Incomer Gantry, provided by the Contractor. The Gantry will be provided by the Contractor as per the Transmission line Termination requirement of PSA as well as the TSS. PSA will terminate the transmission line at the gantry. All the Metering bay structures, foundations and equipment after the point of interface towards the TSS shall be provided by the contractor Package-SYS-1.
- 7.2.3 Check Metering Equipment including all associated metering class CTs and PTs for measuring power consumption shall be installed by the contractor on the incoming supply side of 220/132 kV.

7.3 220kV/ 2x25kV TRACTION TRANSFORMERS

- 7.3.1 The indicative typical TSS conceptual Scheme Diagram and layout are attached in Part-2, Section **VII -3**: Tender Drawings. The Scott — connected traction transformers shall be manufactured and supplied as per *RDSO Specifications No. TI/SPC/PSI/TRNPWR/5200 (latest)*. TSSs shall be provided with 2 Nos. Scott connected traction transformers each.
- 7.3.2 Traction Transformer's minimum ratings are as follows. However, these are to be confirmed by the system simulation study by the Contractor and subject to the approval of the Engineer:-

Table 7.3.2

Salient Features of Scott connected Traction Transformers

Sr.	Parameter	Rating
1	Power Rating (MVA)	60 (Minimum) (ONAN) / 84 (ONAF) / 100 (OFAF) MVA as per General arrangement as referred in Part-2, Section VII -3 : Tender Drawings
2	Cooling	ONAN / ONAF/ OFAF
3	Connection type*	Scott Connected type

- 7.3.3 The transformers shall be installed on a suitable foundation that can withstand the transformers static and dynamic load. The foundation shall be able to support the loads during installation and removal.
- 7.3.4 The substation transformer bays shall be provided with suitable pulling eyes to allow the transformer to be moved and positioned.
- 7.3.5 Each transformer shall be located in its own bund (liquid containment). The bund shall contain stone metal soaking pits with voids of capacity adequate to contain at least 110% of total quantity of oil.
- 7.3.6 The oil drums shall be stored on their own bund to prevent spillage. The bunds used for oil storage barrels shall be positioned so that they do not get filled with rain water.
- 7.3.7 Outdoor oil-insulated transformers shall be separated from each other by fire walls for the purpose of limiting the damage and potential spread of fire from a transformer failure. There shall be a Fire wall between adjacent transformers. Fire wall shall comply with NFPA 221, NFPA 851, IE rules and Indian Standards as per application duty requirement. The wall shall be sufficient to protect adjacent transformers in the event of a catastrophic failure/fire of one of the traction transformers. Fire wall shall be rated for minimum of 4 hour fire rating, the height and length of firewall conforming to IE rules, NFPA 221, 251, 850/851 and designed to withstand the effects of projectiles from exploding transformer bushings or lightning arresters to prevent spread of fire. Firewall provided between transformers should extend at least 30 cm above the top of the transformer casing and oil conservator tank and at least 60 cm beyond the width of the transformer and cooling radiators on either side. The contractor shall calculate the fire load, fire Plume height and fire plume temperature, effect of wind velocity on plume including the forces due to blast if any and demonstrate the adequacy of Fire wall withstand capacity as supported by a calculation or fire modelling.
- 7.3.8 The design of the substation layout shall be such that one transformer can be removed by road without disturbing the operation of the HORC.
- 7.3.9 The safety provision shall comply with Section – 44 of Central Electricity Regulation– 2010 or as revised (measures relating to safety and electricity supply) and CBIP guidelines.

7.4 AUTO TRANSFORMERS

- 7.4.1 The Contractor shall supply Auto Transformers as per RDSO Technical Specification No. TI/SPC/PSI/AUTOTR//1200 (effective from 02.02.2021) and specifications furnished in Chapter 19, Appendix-9 of these specifications in compliance to EN 60076-1 for Capacities and (required if any by simulation) higher than the minimum specified, shall get it approved from the Engineer (if RDSO specification is not available). The auto Transformers shall not be less than the minimum rating and short circuit capacity of auto transformers as per table below:

Auto transformer	TSS	SP, SSP
Rating	12.3 MVA (Minimum) ONAN	8 MVA (Minimum) ONAN
Short circuit Capacity	35 times	25 times

7.4.2 Deleted.

7.4.3 Deleted.

7.4.4 Deleted.

7.4.5 Deleted.

7.4.6 The Auto transformers shall be provided with necessary fire wall between two ATs on the lines of TSS as per applicable standards.

7.4.7 The number of Auto Transformers at each TSS, SP and SSP shall be as follows:

- (i) At each TSS- 4 Nos.,
- (ii) At each SP- 4 Nos.,
- (iii) At each SSP- 2 Nos.

7.5 CIRCUIT BREAKERS

7.5.1 The Traction power supply installations shall be provided with suitably rated Circuit breakers at TSS, SSP and SP. Where gas is used as an Insulation medium, the circuit breaker shall be fitted with a pressure monitoring device that will detect the reduction in pressure and provide a signal via SCADA to the electrical control room.

7.5.2 The command and control signals shall enter the enclosure via pressure tight plug and sockets to provide simple and quick connection and disconnection.

7.5.3 Each circuit breaker shall have a control cabinet with an IP-65 Ingress protection.

7.5.4 The poles shall be able to be operated locally electrically or by a control handle manually from the local control cabinet.

7.5.5 The circuit breaker shall have the minimum of 3 normally open and 3 normally closed auxiliary contacts that are directly driven from the parts of the circuit breaker / interrupter.

7.5.6 25 kV circuit breakers / Interrupters shall be of vacuum type only.

7.5.7 The control cabinet shall be equipped with the following functions:-

- (1) Local and remote operation switch;
- (2) Open and close buttons;
- (3) Open and close indications;
- (4) Operations counter;
- (5) Control indication monitor;
- (6) Capacitor charge indicator.

7.6 BATTERIES AND CHARGERS

- 7.6.1 There shall be two Battery Banks and Two battery chargers at each 2x25kV TSS, SP and SSP stations of required capacity and rating. The Contractors shall furnish the Design calculations for Battery set and Battery charger.
- 7.6.2 There shall be only one Battery Bank and one battery charger at each 1x25kV SP at Sultanpur and Asaudah stations of required capacity and rating.
- 7.6.3 Each battery charger shall be capable of supporting the total substation 110V dc operational load.
- 7.6.4 Each Set of Battery bank shall support 110V dc loads for a minimum of 10 hours.
- 7.6.5 The designs of the low maintenance lead acid batteries and battery charger shall be prepared as per IEEE Std 485 and their capacities and ratings got approved by the Engineer:
- 7.6.6 The 110V battery charger shall be fed from the essential services distribution board that itself will be fed from substation auxiliary transformer.
- 7.6.7 The battery charger shall be located inside the control room. The Batteries shall be located in Battery room or compartment which is vented to outside air.
- 7.6.8 All equipment shall have at least two readily accessible separate earth terminals, which shall be identified by symbol of earth mark adjacent to the terminals.

7.7 CONTROL AND POWER CABLES

- 7.7.1 The cable containment system and run of various cables shall be designed so as to ensure minimum de-rating due to proximity of the other cables adjacent, in tiers and in same duct/ trench. The Cable containment shall conform to IEC 61537 and IS: 1255.
- 7.7.2 Power and Control cables shall be installed preferably in separate cable containments. The Power cables for 25kV & 55 kV shall be Copper conductor, XLPE insulated conforming to IS: 7098 part-3, IEC 60502-2 and tested to IEC 60840 including meeting the type tests requirement. Such HV power Cable shall be manufactured with appropriately sized conductor, formation, Non-hygroscopic Semi-conducting tape, Triple extruded XLPE insulation (semiconducting compound, XLPE followed by the semiconducting compound) with water blocking barrier, Metallic shielding/ screen, armour binder tape and ST-2 class PVC over sheath as per application duty requirement of directly buried cables in Ground. The contractor shall furnish the calculations for considering required thickness of insulation/ construction. All the directly buried cables shall have the cable pull pits/ Pull boxes at all turning at regular and at maximum pull length possible and cable trenches used for The Cable laying shall have the Removable Trench covers meeting the requirement of IEC 61537, IEEE525 and IS 1255.
- 7.7.3 All cable shall be suitable for the environmental conditions as per relevant chapter of this specification. Where cables are installed in trenches or ducts the cable shall be designed to function without any deterioration in fully immersed in water or Insulation oil.
- 7.7.4 Cables shall be indelibly marked regularly along their whole length with generally the following information:
- (1) Manufacturer's name;
 - (2) Insulation material;

**Part 2, Section VII-2 : Employer's Requirements - Particular Specifications (PS)-for 2x25 kV, AC
Traction electrification and associated works**

- (3) Number of cores;
- (4) Cable conductor size;
- (5) Cable nominal voltage;
- (6) Batch no.
- (7) Year of manufacture;
- (8) Country of origin;
- (9) Conductor length (m).

7.7.5 Cable joints shall not be formed in ducts or trenches. Where joints are needed in duct or trenches separate joint bays shall be constructed.

7.7.6 All cables and ducts shall have identification plates fitted at the following locations as a minimum: -

- (1) At all terminations,
- (2) Every 30m along the length,
- (3) At entries/exits through walls or obstructions,
- (4) Entry and exits to ducts or trenches,
- (5) At cable joints.

7.7.7 All cable joints shall be allocated cable joint numbers and each joint shall be physically labelled. The location and joint numbers shall be shown on the as built record Drawings.

7.7.8 25kV A.C. single core cables shall be armoured. All the cable entry points from yard to TSS / SP/ SSP's panel room shall be sealed with EPDM module with fire resistance as per UL 1479 for protection against vermin, rodents and damages.

7.7.9 Cable types required on the project have been indicated in table below, however, the same shall be verified for the performance required.

S. No.	Voltage		Duty	Core Material	Number of cores	Brief Description	Remarks
	Normal (kV)	Maximum (kV)					
2	25 AC	52.0 AC	Traction power	Copper Conductor cable for all sizes	Single Core	FRLS outer sheath armoured XLPE insulated	Cables laid in parallel as required by system design
3	3.3 AC return current	3.3 AC	Traction power return current	Copper Conductor cable for all sizes	Single Core	FRLS outer sheath, armoured XLPE insulated	-Do-
4	0.240 AC	1.1 AC	Power Supply to Equipment	Copper Conductor cable for all sizes	Double core	FRLS outer & inner sheath, Armoured PVC insulated	-Do-

**Part 2, Section VII-2 : Employer's Requirements - Particular Specifications (PS)-for 2x25 kV, AC
Traction electrification and associated works**

S. No.	Voltage		Duty	Core Material	Number of cores	Brief Description	Remarks
	Normal (kV)	Maximum (kV)					
5	0.240 AC and 0.110 DC	1.1 AC	Protection and Control	Copper Conductor cable for all sizes	As required	FRLS HR PVC rated for 105 degree C	Cables laid in parallel as required by system design
6	0.240 AC and 0.110 DC	1.1 AC	Alarm & Emergency Circuits	Copper Conductor cable for all sizes	As required	PVC insulated Fire resistant rated 3 hours rated	-Do-

7.7.10 The cable design and installation shall conform to IEC 60502-1, IEC 60502-2, and IEC 60840 as per appropriate application duty and rated Voltage and IEC 61537, IS: 1255, and Fire Safety Regulations of National Building Code.

7.7.11 Compounds of additives to the cable over sheath shall be anti-termite and resistance and shall comply with internationally acceptable regulations.

7.8 CIVIL WORKS & ILLUMINATION AT TSS, SP, SSP and Tower Wagon Shed

7.8.1 The Contractor shall perform the Civil and Structural design including all calculations and preparation of Drawings, specifications and other documents but not limited to for the following:

- (1) General arrangement (Layout and elevation),
- (2) Earthwork,
- (3) TSS/SSP/ SP control room Building,
- (4) Structures and sub-structures for indoor equipment,
- (5) Foundations (M-20 grade concrete) for all the major equipment including associated protection equipments as planned for Main and Standby Transformers and organizing the layout accordingly to accommodate the future provisions and capacities of the equipment for double line section,
- (6) Cable trenches with covers,
- (7) Drainage (Covered type),
- (8) Networks (Water Sewage etc.),
- (9) Fire wall between the transformers,
- (10) Transformer/ auto Transformer weight carrying Road in side TSS/SSP/SP,
- (11) Boundary wall / Fencing.
- (12) Tower Wagon shed with inspection pit.

7.8.2 The Contractor shall execute all the civil works and electrical works at TSS/SSP/SP and Tower Wagon Shed etc. as under but not limited to:

- (1) Power supply Control rooms of TSS/SSP/SP, Tower Wagon Shed and Service buildings

- (2) Gravel spreading (single sized aggregate of nominal size 20 mm) shall be minimum 150mm as per requirements of IEEE-80-2013,
- (3) The Top most level of the trench shall be finished not less than the plinth level and about 100mm above the Gravel level in the switching yards of the TSS, SSP, SP etc. to avoid spill over of the gravels in to open trench if any.

7.9 CONTROL ROOM, TOWER WAGON SHED AND YARD LIGHTING

- 7.9.1 Contractor shall design and construct the substation buildings for TSS, SSP, SP and Tower Wagon Shed and shall be responsible for land preparation, boundary wall, entrance gate, foundation, support anchor block, door, windows including architecture, civil, structural, drainage, plumbing, conduiting, wiring, provision of lights, fans, Exhaust fan etc. All such parts and accessories shall be deemed to be within the scope of specification whether specifically mentioned or not. The soil investigation for foundations for building work etc shall be undertaken and Engineer's approval shall be taken. Electrical resistivity of soil for designing safe grounding system shall be done. The site shall be fit to support the transportation of heavy equipment, including transformers whose weight may be in the range of 100-150 Tonnes or higher. In TSS, SP & SSP, Contractor shall provide a road & rail system integrated with transformer foundation to enable installation and the replacement of any failed unit . The Contractor shall take such rail road system to the adjoining approach road for easy transport of the transformers and heavy equipment through rail/road transport.
- 7.9.2 All buildings shall be provided with concealed GI Conduits for all wiring works. Building signages of LED type shall be designed and provided.
- 7.9.3 The functional and structural design of buildings shall conform to National Building Code. Load due to earthquake shall be assessed as per provisions of relevant IS Code with latest amendment.
- 7.9.4 The grade of concrete should be as per approved design and minimum M-25 as per IS 456 for all civil construction of buildings, cable trenches and precast removable RCC covers. The cement plaster shall be 1:4 (cement: sand) and brick class designation of less than 10 shall not be used. The site shall be cleared of all existing encumbrances, levelled and compacted. The earth compaction shall not be less than 95%. The finished ground level of substation site shall be above the highest flood level (HFL) in the region. The finished ground level shall be at least 600 mm above the main rail /road level near to the site as given in drawing.
- 7.9.5 The drainage of substation shall be provided as per best engineering practices to prevent surface flooding and pooling of water. Suitable drainage system and ground water recharge pit shall be made. Trenches shall be provided with suitable slope so that no water remains in the trench and all water is diverted to recharge pit. The trench beds shall have a slope of 1/500 along the run and 1/250 perpendicular to the run. The top of the trenches shall be kept at least 100 mm above the finished ground level. The top of cable trench shall be such that the surface rainwater does not enter the trench.

- 7.9.6 The ceiling height of the substation building shall be minimum 4.2 metre above floor level. The plinth of the substation building shall be 300 mm above the natural ground level of substation. All fencing items i.e., wire mesh, angles, flats etc shall be GI.
- 7.9.7 All windows of substation building shall be fitted with burglar bars firmly attached to the structure of building and shall be of an area about 20% of room floor area. The windows shall be of appropriate section and shall be fitted with locks. The windows shall be provided with minimum 5mm thick toughened glass. Doors and shutters shall be sturdy and having corrosion proof material. Continuous sunshade (minimum 500 mm) shall be provided on windows and doors to avoid of ingress of rain water. Storage space with doors and locking system shall be provided.
- 7.9.8 The battery room shall be provided with exhaust fan and acid resistant tiles on the floor and on the side walls upto height of 1.5 meter. The ceiling shall be painted with acid resistant paint.
- 7.9.9 Toilet rooms and water supply arrangement shall be made in the substation building along with provision of submersible pump. Water supply shall be available for 24 hours a day in TSS/SP/SSP buildings.
- 7.9.10 Substation building shall be provided necessary lighting and fans. The wiring conduits shall be concealed. The power points, AC points as required shall be provided. The wiring shall be with copper cables. Substation building shall be properly earthed against any lightning. Yard lighting with proper luminaires shall be done with proper cables and switching system.
- 7.9.11 The Contractor shall provide suitable pathways/roads to afford easy reach to equipment in the switchyard. A motorable road suitable for heavy equipment shall be provided to permit vehicle movement from switchyard heavy equipment up to control room of TSS/SP/SSP and from control room to Entry/exit gate(s). Motorable road for vehicle movement up to Tower Wagon Shed shall be constructed.
- 7.9.12 The Contractor shall provide roads within the TSS/SP/SSP of Reinforced Cement Concrete (RCC) to permit transportation of all heavy equipment. The roads shall have minimum 5 m wide RCC road in TSS and 4 m in SP/SSP. Road construction shall be as per IRC standards. For this purpose, the Contractor shall prepare the necessary design and calculations and submit them to the Engineer and shall construct roads as per approved designs.
- 7.9.13 Necessary trenches inside the building shall be made and these shall be covered with GI chequered sheets 8 mm thick. GI support angles/trays shall be provided for cable laying.
- 7.9.14 The indicative layout of the substation, fencing, retaining wall etc. along with area has been given in the Tender drawings. *RCC M25 Grade retaining walls shall be provided on all 4 sides of TSS, SP and SSP.* Contractor shall submit the final layout design for Engineer's

approval after taking into consideration the sizes of various equipment etc.

- 7.9.15 Tower Wagon Shed shall be constructed with inspection pit and maintenance facilities. Necessary lights in inspection pit and in the shed area, exhaust fans, power points and power sockets for welding/heavy work shall be provided. The plinth area of the shed shall not be less than as indicated in the drawing. The cables wherever cross the floor shall be through HDPE pipes not less than 75 mm dia (PN-4). The pit lights shall be provided with bulk head light fixtures on each side of the pit (wall) to cover entire length. 6 Amp and 16 Amp sockets with switches outdoor type shall be provided at interval of 5 meters. 32 Amp three phase sockets with 4 pole MCB shall be provided at both the ends of the pit.
- 7.9.16 The Contractor shall provide tracks for the entire length inside the Tower Wagon Shed along with all fixtures. The rail shall be provided free of cost by Track Contractor at a nominated depot at Manesar. All the fittings, nuts, bolts etc of the track shall be provided by the Contractor.

7.10 NUMBERING OF EQUIPMENT

The number plates of equipment in TSS and switching stations shall be non-retro reflective type and meet the guidelines of ACTM Vol.II. The Equipment Numbering Scheme shall be approved by the Engineer (with the consent of Employer) and will be updated to make it compatible with adjacent section.

7.11 220kV/132 kV, 55KV AND 25KV BAYS, LAYOUTS AND BUS BAR ARRANGEMENT

The 220/132 kV, 55kV and 25kV bays shall be arranged as per the general arrangement layouts of TSS, SSP and SP. The bus bar in 220/132 kV bays may be flexible type whereas on 55kV and 25kV bays shall be suitably sized rigid aluminum bus bar type for higher short-circuit withstands capacity, reliability and Maintenance friendliness suitably rated for Thermodynamic stress due to short circuit in conformance to relevant IEC/ EN standards.

(End of Chapter 7)

CHAPTER 8 – DESIGN CRITERIA AND PERFORMANCE SPECIFICATIONS FOR FLEXIBLE OVERHEAD CONTACT SYSTEM(OHE) AND RIGID OVERHEAD CONDUCTOR SYSTEM

8.1 GENERAL REQUIREMENTS

8.1.1 General

- (1) This specification covers complete design, supply, construction, installation, testing and commissioning of High-Rise Overhead Equipment (OHE) & ROCS in twin Tunnel for main lines, yards, viaduct and connecting tracks to Indian Railways and DFCCIL to provide traction power to trains having trailing loads as per "Train operation plan" in clause 5.2.
- (2) The OHE design shall conform to technical, operational, economical, maintenance and application duty requirements and shall be suitable for local environmental conditions. The OHE system shall be designed as per application duty requirement with sufficient capacity with redundancy to cater to foreseeable load /current demands, without any degradation of any of its components. The OHE design shall be coordinated with the locomotive dynamic performance characteristics to ensure that the current collection quality is maintained within acceptable limits. Overhead contact line shall also be designed, constructed and maintained in such a way that due regard is given to safety of the public, durability, robustness, maintainability and environmental considerations as per EN 50119.
- (3) The principal components of the scope of work shall include but not be limited to the following:
 - (a) Complete 25kV Auto Transformer (AT) fed, flexible polygonal sagged simple auto-tensioned Overhead Equipment (OHE) including parallel reinforcing conductors along the track, foundations, steel structures, 2x25kV feeders and cross track cable terminations and associated insulators and hardware, jumpers;
 - (b) (+)25kV and (-)25kV cable/Overhead feeders and flexible cable feeder connections from track-side bus to the tracks;
 - (c) Traction Return current Path through rail, negative feeders, AEW and BEC (if required).
 - (d) Track Bonding and Earthing;
 - (e) Survey and execution of Safety Earthing of other Service Buildings, adjacent steel structures alongside the track including those of Indian Railways and DFCCIL alignment running alongside as required;
 - (f) Provision of Isolators
 - (g) 25 kV OHE system for yard lines at the stations and for the connecting chords of IR.
- (4) The OHE shall also accommodate the requirements of systems associated with the locomotives & rail wagons, such as clearance envelopes, other schedule of dimensions, signalling and telecommunication systems.
- (5) The OHE shall be designed for two pantograph operations at full design speed,

- (6) It would be essential to have computer software-based OHE designs to the extent possible so that repeated detailed calculations are reproducible easily for different locations and loading conditions of overhead equipment for ease of quick & techno-economical designs through computer software in compliance with EN: 50119.
- (7) For ease of construction as well as maintenance and smooth inventory control, designs of different fittings, fixtures, insulators, droppers, clips, clams etc. should be of maximum interchangeable types.

8.2 FACTORS GOVERNING DESIGN OF OHE

8.2.1 Design Speed

- (1) The Overhead Equipment of HORC main lines shall be of simple sagged polygonal type design (ROCS in Tunnels) auto – tensioned in *conformity with RDSO* and shall be designed for maximum permissible speed of 160 kmph.
- (2) *The OHE for loops shall be designed for maximum permissible speed of 50 kmph and connecting lines shall be designed for maximum permissible speed of 100 kmph.*
- (3) *The testing of OHE shall be done at 10% more than the maximum permissible speed.*

8.2.2 Earth work

The actual details of the earth work including formation width, embankment, curves, cant and other track parameters shall be obtained from Civil contractors for OHE system design and continuously coordinated for access with civil contractors. The indicative values are, however, given in General Specifications, Maximum Moving Dimensions (MMD) and Structure Gauges as per the details given in the Indian Railways Schedule of Dimensions, 1676 mm Gauge (BG) – 2022 (with latest advance corrections slips).

8.2.3 OHE structures on bridges

- (1) Locations and details of Major bridges/RFOs may be referred to in the alignment drawings and typical arrangement drawings given in Part-2, Section VII Volume 3 : Tender Drawings of these documents. Structures to support traction overhead equipment may be required to be provided on the bridge piers. Exact span of Bridges shall be taken from the various Civil contractors undertaking the civil works in the section.
- (2) On long bridges and long viaduct, OHE anchors and supports may also be required on bridge/structures itself. On through girder bridges, the overhead conductors and pantograph swept path shall have to be provided with adequate electrical and mechanical clearances. These may need special designs to meet the additional clearances and support requirement.
- (3) The design and erection of OHE structures on these bridges and earthing & bonding of all structures shall be carried out in close co-ordination with the Civil contractor.
- (4) For OHE masts to be erected on bridges and viaducts, the Civil Contractors working in various parts of the Pirthla – New Harsana Kalan section shall provide *bolts with nuts and washers with template*. The Contractor shall interface with Civil Contractor so that masts with base plate are ordered and fabricated at the

supplier's works and duly galvanized after welding and drilling holes in the base plate. *The implantation of OHE mast at viaduct and on composite girder bridges shall be as shown in Tender drawings.*

8.2.4 Minimum clearances to be adopted

Table 8.2.4 -: Minimum E & M Clearance (mm)

Item	Normal
25kV Live metal to Earth - Static	250
- Dynamic (passing)	200
25 kV Live metal to vehicles - Static	290
- Dynamic	220
Clearances for different phase (50 kV) - Static	540
- Dynamic (passing)	300
Between conductors of different Electrical Sections Gap at Insulated Overlap	500
Gap at Un-insulated Overlap	200

- (1) Mechanical clearance from the pantograph to any fixed structure, excluding the registration assembly, steady arm or registration pipe of the cantilever, shall be not less than 200 mm, except at locations where a locomotive is expected to halt as a matter of normal operation. Clearance to steady arms and registration assemblies or tubes used for registration purpose shall not be less than 35 mm under worst case operating conditions including dynamic displacement of the vehicle, the pantograph as well as track and maintenance tolerances.
- (2) Contact wire gradients and change in the gradient shall be in line with *RDSO Instruction No. T/IN/0042 and EN 50119 (whichever is more stringent)*.
- (3) Under Indian climatic conditions, particularly during peak summer months, where the temperature goes as high as 50°C, the thermal expansion of aluminum and copper conductors are different. This has been particularly posing problems while passing OHE traction wires & return feeder wires under heavy over line structures and in areas with thick vegetation growths. Therefore, Contractor shall conduct a study and provide clearances as needed. The clearances as indicated are minimum and the clearance between live and dead / earthed portion may be increased where ever possible particularly the stranded conductors, to avoid tripping due to birds coming in proximity and bridging the gap and getting electrocuted, and increasing the reliability of the OHE system generally conforming to General arrangement Drawings of RDSO or Other Standards whichever gives more reliability.
- (4) At over-head bridges, clearances from top of rail to the underside of bridges shall be scrutinized to ensure that adequate vertical clearance is provided: that is linked to the height of the vehicle, the electrical (air) clearance, the height of the catenary, catenary tolerance, track tolerance, bridge structure tolerance (for a new overhead bridge). Criteria for determining minimum vertical clearance are given in the ACTM. To achieve sufficient clearance at over-head bridges,

grading of the catenary system height down while maintaining a level contact wire, is an option.

8.2.5 Aerial Earth Wire (AEW) is generally kept at higher level to serve the purpose of lightning protection, however the AEW height/ level at the lowest point shall not fall below the contact wire level at the maximum temperature. The Contractor shall arrange the OHE arrangement as per drawing annexed in Part-2, Section VII Volume 3 : Tender Drawings.

8.2.6 The following design features of OHE as on Indian Railways may be adopted to, for similarity with IR system:

(1) Normal Encumbrance: (Axial Distance between Contact wire and the Catenary wire in a vertical plane at the structure): 1.4m.

(2) Standard spans

OHE spans shall be in multiples of 4.5 m from a minimum of 27 m to a maximum of 54 m span length, the designer shall consider the effects of the following but not limited to:-

(a) OCS (Overhead Conductor System) conductor blow off,

(b) Contact wire height,

(c) Contact wire stagger,

(d) Contact wire mid-span offset,

(e) Contact wire stagger effect on tangent track,

(f) Contact wire deviation due to track movement,

(g) Mast deflection due to imposed loading,

(h) Vehicle dynamics,

(i) Width and sway of the pantograph,

(j) Track tolerances, and

(k) OCS erection tolerances,

(l) Pre sag 0.8 mm per metre (maximum)

(3) Stagger of Contact Wire:

(a) On straight : 200 mm

(b) On curved track : 300 mm

(4) The maximum distance between anti-creep to the Anchor structure: 750m as on Indian Railways.

(5) Overhead Equipment (OHE) Mast /Structures for the mainline tracks shall be mechanically and electrically independent except where specifically approved by the Engineers. Design for steel structures shall comply with IS: 800 which is the Indian Standard Code of Practice for use of Structural Steel. Design method as adopted in Indian Railways design manual for electric traction may be followed for guidance. Concrete structures shall not be used.

8.2.7 The OHE System shall be suitably designed to integrate with the OHE of adjoining sections of DFC and IR for smooth sailing of pantograph mechanically and electrically,

giving due consideration to the prevailing weather conditions.

8.3 SECTIONING OF OVERHEAD EQUIPMENT

8.3.1 Introduction

HORC's Stations are generally 10 — 17 km apart with crossing stations for giving precedence to trains. The OHE is divided into electrical sections for maintenance and operating purposes to cater to over-head equipment failures, isolation required for emergency work, apart from isolation for routine maintenance. The switching 'ON' & 'OFF' of OHE for main line sections and yards, shall generally be through remote control from the Operation Control Centre, however, it shall also be operable manually for local Power Blocks. On mainline sections, electrical sectioning is normally provided by insulated overlaps. The section is divided into smaller zones by way of switching stations or isolation of different sections, whenever required. A continuity of the electrical sections is maintained as per approved scheme through circuit breakers, interrupters (on load switches) and off load disconnects switches which may be motorized or manually operated. The sectioning shall be minimum, to provide for flexibility of operation. The indicative sectioning layout for Prithla to New Harsana Kalan section is shown in the Part-2, Section VII Volume 3 : Tender Drawings. The Entire section between Prithla to Harsana Kalan shall be sectionalized through TSS, SSP, SP and Sectioning Switches (motorized Isolators) at Stations for main line. Mid-section isolations are not planned; however, isolations shall be provided as essentially needed for minimizing the affected sections in case of faults, without impacting receipt and dispatch at the station through healthy lines. The OHE between the Stations may be under Power block in case of Maintenance or failure, the station Loops shall be planned to be isolated through the Motorized Isolators.

8.3.2 The OHE shall be sectionalized through remote controlled switching and auto fault localisation , so as to maximize the availability of operational track in the event of:

- (1) An overhead equipment failure.
- (2) OHE failure due to external cause.
- (3) An isolation required for routine maintenance.
- (4) Isolation required for emergency work.

8.3.3 Sub-sectioning Post (SSP)

The SSP sectioning shall be arranged such that movement to various lines and yard line is maintained, by isolating the smallest portion of tracks for maintenance or breakdowns. Portions of station yard can be made dead whilst the rest of the mainline and yard is energized and vice versa.

8.3.4 Sectioning Post (SP) and Traction Substation (TSS)

At SP and TSS locations, there shall be sectionalization to allow one sub-sector/section to be isolated from the next section. The section isolation shall be arranged such that safe isolation can be made for maintenance purposes, whilst the adjacent section remains alive. Autotransformers are connected on either side of the Neutral section serving as the last AT of the respective feed section.

8.3.5 Isolation of Faulty Auto transformers

To isolate faulty auto-transformers, each auto-transformer will be automatically

disconnected through Circuit Breakers across the Transformer as per IE rule and approved protection scheme. All the Circuit breakers provided for Auto Transformers at TSS/SSP/SP shall be with double pole isolators to facilitate its maintenance. It shall be possible to isolate the faulty Auto Transformer as well the section fed remotely through SCADA.

8.3.6 Position of Sectioning Switches (motorized isolators)

The Sectioning switches (motorized isolators) as required for facilitating the adequate sectioning shall be considered before and after the stations as appropriately required. Sectioning Switches shall be suitably configured to facilitate easy isolation through SCADA in case of maintenance and occurrence of OHE fault. Single Sidings/ loop lines shall be isolated through Motorised Isolators.

8.3.7 *HRIDC is providing a single line connectivity with 1x25kV High Rise OHE from MSIL plant at Manesar to Patli station (IR) via Manesar yard Line No 1. Due to restricted space between the two adjoining tracks, only portal shall be provided in Manesar yard and its approaches as shown in the Tender drawings.*

8.4 OHE CONDUCTORS

(1) Minimum Sizes of Conductors

The contractor shall design the Traction system conductors sized to meet the requirements for freight traffic to be hauled as per HORC’s “train operation plan” and as given in clause 5.2.2 of these specifications. The Minimum sizes of conductors are mentioned in the Table No. 8.4-1 below:

Table: No 8.4.1: OHE Conductors

Conductor	Minimum Nominal Size (mm²)	Material	Remarks
Catenary	120	Copper Alloy	Material having temperature withstand capacity minimum 100 ⁰ C as per EN50119 and conforming to DIN 48201 (Part II) or RDSO Specification No. TI/SPC/OHE/CAT/(Cu-Cd)/0971 (latest).
Contact wire	150	Copper Alloy	Material having temperature withstand capacity minimum 100 ⁰ C as per EN50119 and conforming to EN50149 or RDSO Specification No. TI/SPC/OHE/CW/0971 (latest).
25 kV Feeder Wire	288	AAAC	Material having temperature withstand capacity minimum 80 ⁰ C as per EN 50119 shall be used.
Aerial Earth Conductor	92	ACSR	Material having temperature withstand capacity minimum 80 ⁰ C as per EN 50119 shall be used.

Buried Earth Conductor	As required	Galvanised Steel	Material having temperature withstand capacity minimum 80 ⁰ C shall be used.
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(2) Catenary (Messenger) Wire

The catenary wire shall be minimum 120 mm² copper alloys conforming to *RDSO Specification No. TI/SPC/OHE/CAT/(Cu-Cd)/0971 (latest)* or DIN 48201 – Part 1 and Part 2, EN 50119, DIN48200, DIN 48203 or any other equivalent international standard capable of withstanding minimum temperature of 100⁰ C.

(3) Contact Wire

(a) The contact wire of minimum 150 mm² shall be manufactured out of continuous cast rods by any process conforming to EN 50149/ or RDSO guidelines and withstand a minimum temperature of 100⁰ C continuously without affecting the mechanical properties as per EN 50119. The Contact Wire shall be BC type (Round Bottom).

(b) The contact wire shall be continuous, i.e. splicing or jointing of the conductors is not permitted between terminations or between cut-in insulators. Splices are primarily used during maintenance and shall not be used in the contact wire and / or catenary wire by way of installation or repair unless approved by the Engineer.

(4) The (minimum) height of contact wire shall be 7220 mm from rail level as per IRSOD-2022 as amended (latest) or the recent guidelines issued by Indian Railways. The track raise allowance of 275 mm shall be kept.

The OHE shall be designed in such a way that it shall be possible to raise contact wire height to 7570mm. Contact wire shall be installed at height ranging from 7220mm to 7570mm from rail level as given in IR-SOD including correction slip issued before finalization of design. Minimum height of OHE mast shall be 11.6 m.

(5) Aerial Earth Wire (AEW)

Aerial Earth wire (AEW) of adequate size and rating shall be provided aerially adjacent parallel to or above the OHE conductors, attached to OHE supports collectively to ground or to the grounded running rails to protect people and installations in case of electrical faults. AEW provides a continuous return path to fault/leakage current through insulator if any or earth fault between live OHE and the earthed masts and connects to BEC (if required). AEW shall be located suitably to efficiently protect against the lightning stroke. The design shall determine therequired spacing of interconnections to the rails which must be coordinated with requirements of compatibility with the signaling system. AEW shall be of AluminumConductor Steel Reinforced (ACSR) material of appropriate size with fixed termination and erected on mast parallel to the OHE system as per the results of simulation study conducted by the contractor.

(6) Buried Earth Conductor

Buried Earth Conductors (if required) of appropriate size, as validated through calculations, taking in to account the possible corrosion over 25 years life, shall be laid on the alignment and connected to AEW and running rails of the track at

regular intervals. This shall be confirmed through the traction power load flow simulation results and the touch / step volts analysis to keep the rail Touch and Step potentials within acceptable limits, both for normal and OHE/feeder fault conditions, as per EN 50122-1 generally as per scheme given in Part 2, Section VII-3.

(7) Negative Feeder Wire (NFW)

In 2x25 KV traction systems, OHE line will be equipped with negative feeder wires of AAAC, supplying power to auto-transformers. The NFW will be strung from the super masts attached as extensions on the OHE masts or Extended OHE mast. The NFW shall normally be placed on the track side of the mast. The suspension insulators of NFW shall also follow the norms as given for OHE. The clearance between feeders and the catenary system should remain adequate under adverse wind & highest ambient temperature conditions including gap as essential to minimise the electrocution of birds/ crows as per schematic attached in Section VII-3.

(8) The proposed sizes of all types of conductors, including jumpers, droppers etc. shall meet the application duty requirement and will be validated through detailed design calculations and the results of simulation studies. The Conductor of higher sizes shall be provided, if needed as per the results of simulation study conducted by the contractor. The Contractor may where practical, optimize on the number of parallel feeders and shall install them where necessary.

(9) The multi train simulations shall be used to prove that the wire temperatures are within design limits as stipulated in EN-50119, under all operational configurations. The Contractor shall identify any operational limits in the design report.

(10) Particular attention shall be paid to design and construction of OHE at critical locations of cross-overs and turn-outs so as to minimize/eliminate the possibility of panto-entanglement with the contact wire in conformance to EN:50119.

(11) The tension length of OHE is governed by the limitations imposed by the expansion and contraction due to temperature changes and the system design chosen to accommodate this change while providing suitable tensioning of the system. While defining the maximum tension length, particular attention must be paid to the along-track movement and stagger change. Tensions to be adopted in different overhead conductors shall be specified by the designer along with the system of anchoring. The tension length and contact wire pre-sag and gradient shall be decided, supported by the requisite calculations, for smooth and spark-free current collection by the loco pantographs.

8.5 SPLICES, CLAMPS AND OTHER TENSION FITTINGS FOR THE CONDUCTORS

8.5.1 The performance of fittings designed to terminate or splice stranded or individual wires is critical to the efficient operation and maintenance of the OHE.

8.5.2 The OHE fittings shall be tested in tension, in a special Jig to simulate the load characteristics experienced in service. The contractor shall demonstrate its suitability by FEM Analysis.

8.5.3 The tensile failing load of the fitting shall exceed the failing load of the wire or stranded

wire with which it is to be assembled and used.

- 8.5.4 When the fitting is tested and assembled to the allocated wire or stranded wire the assembly shall achieve 85% or greater than the specified tensile failing load of the wire or stranded wire.
- 8.5.5 Applicable factors of safety for design shall be as per European standards EN 50119.
- 8.5.6 Splices are primarily for use during maintenance and shall not be used in the contact and/or catenary wires by way of installation or repair. If need arises due to any exceptional reason, same shall be done with specific approval of Engineer.
- 8.5.7 Unless otherwise specified in this bid document, all bolts, studs, nuts, washers and pins used for the current carrying conductors shall be of stainless steel or high tensile copper alloy. However, for all other applications, galvanized steel may be used with particular reference to the prevention of corrosion.
- 8.5.8 All fittings, components and materials to be used on the Project shall be subject to prototype tests as per provisions of Employer's Requirements.\

8.6 ELECTRICAL CONNECTIONS

- 8.6.1 The connections shall be robust, to withstand both static and dynamic loads, along track movement, wind pressure (Temperature variation in conductors and operational vibrations).
- 8.6.2 Design of fittings and connections shall ensure no localized temperature rise at the connection to prevent any damage or deformation or adversely affect the mechanical capacity of the conductors or their electrical performance.
- 8.6.3 Where dissimilar connecting materials are used appropriate measures shall be employed to mitigate the risk of bimetallic corrosion.
- 8.6.4 Protective bimetallic tapes and shells shall be used at clamps and terminals used with aluminium and copper conductors and cables.
- 8.6.5 Nominal working pressure shall be kept up to compensate the permanent temperature deformations and generation of local overheats.
- 8.6.6 The tapes and shells shall envelope 10mm outside of clamps on both sides.

8.7 FLEXIBLE JUMPERS AND FEEDER CONNECTIONS

Flexible Jumper Wire shall be fabricated from soft annealed, high conductivity copper with stranded conductors. The size of the jumpers shall be decided based on simulation study and temperature rise shall be within limits in extended feed conditions. The jumpers shall conform to DIN 43138. The capacity of jumpers, cross feeder wires, drop jumpers from cross feeders, along feeder wires, isolator jumpers etc shall match the capacity of OHE (catenary and contact wires) and their size shall be uniform in the entire section. The size and no. of parallel runs of cross feeders, along feeders etc shall remain the same for OHE & NFW.

8.8 FLEXIBLE DROPPERS

Flexible droppers shall be of minimum nominal cross section of 10 sqmm and shall conform to DIN 43138. Each current carrying dropper shall be of bronze strands and two dropper clamps, one of which is connected to the contact wire, and the other to the catenary wire. The maximum resistance at the joint between the bronze dropper wire and the clamp, and at the contact point between the clamp and the catenary and contact wire, shall be less than the resistance of the conductor of the same length. The maximum temperature rise at the joint and at the contact surface shall not be higher

than that of the conductor. The tensilebreaking load of the complete joint shall not be less than 90% of the failure tension of the dropper wire. The factor of safety for flexible droppers shall be as per EN 50119.

8.9 BURIED EARTH CONDUCTORS (BEC, if required) Connections

- 8.9.1 The Contractor shall connect AEW, BEC (if required) and running rails of the tracks at regular intervals to keep the rail touch and step potentials under acceptable limits both for normal and fault conditions including Auto Transformer Failure Condition. It shall be the responsibility of the Contractor to determine the sizes of the AEW and BEC (if required), distances of their connection to rails /earth so as to ensure a safe system both under normal and fault conditions as per EN-50122-1. For the calculation purpose time duration for clearance of fault may be considered as 300ms.
- 8.9.2 BEC (if required) conductor shall be connected to Rail, Masts and earthing stations by the contractor as per the indicative Scheme given in Section VII-3.

8.10 CANTILEVER ASSEMBLIES

- 8.10.1 The cantilever assembly shall conform to EN 50119. The Contractor may adopt the cantilever assembly conforming to RDSO / IR specifications/ maintenance friendly with modular design proven in any international project, if it meets the functional requirements of the project. In case the Contractor offers any new Cantilever Assembly design, the same shall meet the proven design criteria as per clause 4.4.2 of chapter 4 of this specification. Cantilever made of fiber shall not be used.
- 8.10.2 The Contractor shall ensure that the range of cantilever frame components is suitable for the loadings and applications shown in the Drawings and these Specifications.
- 8.10.3 The proposed cantilever frames will sustain the normal and worst-case loading conditions with a factor of safety not less than 2.5.
- 8.10.4 The cantilevers shall be designed such that they can be pre-assembled off site for delivery to site. FEA (Finite Element Analysis) of the Cantilever Assemblies shall be carried out and got approved from the Engineer.
- 8.10.5 The contact wire registration profile shall accommodate the permissible extremes of uplifted and swayed pantograph movement in addition to the effects of track tolerances and include allowance for mechanical and electrical clearances and to be in accordance with the stipulations of IR SOD-2022 (with latest correction slips).
- 8.10.6 Fittings connected to the in-run contact wire shall utilize the wire groove and shall be shaped to maximize clearances to the pantograph head when uplifted by the extreme operating running conditions and shall take account of pantograph and contact wire wear and to be in accordance with the EN/ IEC standards.
- 8.10.7 Assemblies shall allow for the adjustment of contact wire stagger and the equivalent catenary adjustment by 75mm either side of the designed position without changing components.

8.11 OHE ASSEMBLIES, FITTINGS, HARDWARE

- 8.11.1 The fittings, tubes and hardware shall confirm to RDSO/CORE (Indian Railways)

specifications for these items subject to their suitability for the ratings and situation applicable for use on the HORC corridor where the Contractor offers components of different ratings, design or configuration conforming to other National and International specifications of proven design, details of the specifications and performance elsewhere shall be furnished for approval as per provisions in clause 4.4.2 of chapter 4 of these specifications.

- 8.11.2 All threaded fasteners, washers, headed pins and locking pins etc. shall generally conform to appropriate Indian Standards Specifications. The Contractor shall prepare and submit for the Engineer's approval a list of all applicable specifications for threaded fasteners, washers, headed pins and locking pins etc.

8.12 AUTO TENSIONING DEVICES

The tension in the contact and catenary conductors of the flexible overhead equipment shall be regulated at all temperatures by auto-tensioning devices of proven design at both ends. The Auto Tensioning Device (ATD) shall conform to *RDSO Specifications* or EN 50119. The contractor may adopt anchoring of catenary and contact wire on the same mast through regulating equipment as per application duty requirement. The breaking strength of the stainless steel wire/rope shall not be less than 2.5 times the maximum computed working load. *Three pulley type ATD shall only be used for regulation of OHE. ATD shall provide a constant tension of 2400 kgf (minimum) in the traction overhead conductors.*

8.13 25 KV CABLES

- 8.13.1 25 kV, ac, cables shall be XLPE Insulated, armoured, single core copper conductor Cables conforming EN/IEC 60502-2, IS:7098-3 meeting the application duty requirement and tested to EN/IEC 60840 as per the 52kV (for 25 kV) class Insulation. The insulation thickness shall meet the Testing requirement of EN60840. The outer sheath of the cables shall be protected against ultra violet radiation. The Cables laid in the ground shall be provided with Radial and longitudinal wateringress protection in terms of relevant standards and shall be tested for water penetration test. The Cable shall conform to the laying method requirement and de-rated suitably as per the stringent condition witnessed by the cable. The Conductor shall be provided with semiconducting screen tape and triple extruded layers of semiconducting compound, XLPE and semiconducting compound with Longitudinal water absorption/protection layer /insulation metal shield, Round wire armoured, Binder tape and Over sheath at least ST-2 class as per application duty requirement.
- 8.13.2 In order to protect the insulated cables and associated equipment from atmospheric voltage surges, TSS and traction switching station feeder cable connections to the OHE shall be provided with gap less lightning (surge) arrestors with leakage current detector and surge counters.
- 8.13.3 Cables shall be placed in protective metallic Pipe/ conduit to protect the cable vertically up to a height of 1.8m above the ground to protect against mechanical damages/ vandalism. The Bottom end of metallic conduit shall be embedded in the concrete/ the plinth level of structure and top end shall be sealed to avoid the trapping of the Rain water.
- 8.13.4 All the Cables shall use the Heat shrinkable Termination kits as per the applicable standards to protect against the ingress of water and terminations.

8.14 STRUCTURE/UPRIGHTS AND THEIR FOUNDATIONS

- 8.14.1 Overhead equipment structures for the main line tracks shall be mechanically and electrically independent except where specifically approved by the Engineer. In station yards, having 3 or more tracks, portals shall be erected as per yard plan. Portals with larger number of tracks as per yard plan may also be required in station yards. For this purpose, adequate track centers shall be provided by the Contractor . *Single mast at stations, platforms and yard shall be avoided.* Design for steel structures shall comply with IS 800— Indian Standard Code of Practice for use of structural steel in General Building Construction. *Pre-stressed concrete mast shall not be adopted. On station platforms and in station yards dwarf mast anchors RDSO Standards shall be provided at anchoring locations.*
- 8.14.2 The structures / uprights shall be embedded in *RCC foundations*. The Concrete for the foundations shall conform to EN50119, BS 8004. In view of the faster installation requirements mechanically augured / excavated, Cast in Situ Cylindrical foundations not less than M-20 grade concrete of suitable size shall be provided. Rectangular foundations design of Indian Railways may be used by the Contractor at specific locations with the approval of the Engineer. For RCC foundations, the reinforcement shall be connected to the Mast for ensuring it as an Earthed structure as per EN 50122-1. Precast prefabricated foundation shall not be used. *Exposure of foundations shall be as per RDSO Specifications.*
- 8.14.3 The Contractor shall carry out geotechnical survey. This data shall form the basis for design for foundation as per EN50119. The Contractor shall undertake sufficient Geo-Technical investigation to demonstrate that the foundation designs are adequate. The consideration shall be given while design of Foundation to all the factors including the electrical resistance of the foundation to earth as per EN50119 and foundation design calculations shall be furnished. *The soil bearing capacity as calculated from geotechnical survey or 11000 kgf/sqm, whichever is less, shall be used for design of foundation. The soil investigation shall be carried out at every 500 m (maximum) as per relevant IS Codes.*

8.14.4 Location and Setting distance of Structures

- (1) Location of structures shall be selected after ensuring that there are no infringements and they do not obstruct roadways, pathways, run of cables, drains, or signals etc.
- (2) Setting distance of fixed structures shall not be less than that specified in IRSOD for HORC. This shall be, however, subject to review by the Engineer. The location of traction masts shall be such that visibility of signals is not obstructed and shall be as indicated in ACTM. The OHE supporting masts/portals/ drop arms etc. shall be coordinated with signals locations to ensure clear signal visibility.

(a) Extra clearance on Curves

The minimum setting of structures on curves shall be increased by the figures for curve allowance being taken from *IRSOD (latest)*.

(b) Structures with Counter Weights

In case of structures carrying counter-weight assemblies, the term "setting" shall refer to the minimum distance of the mast including the

counter-weight from the track center. The minimum and maximum travel of counter weight shall be marked on the mast along with reference temperature.

- (3) To ensure provision of safe & efficient current collection under adverse conditions, the deflection of masts on top of the OHE structure shall not exceed 8 cm and the mast shall be erected such that it becomes vertical on application of permanent loads. The mast shall not further deflect more than 8 cm under the wind load. Torsional deflection under permanent loads shall not exceed 0.1 radian.
- (4) The value of setting distance of masts/structures shall be painted on each mast/structures. The figures shall be 25mm in size in white on a red background. In addition, the track level, contact wire height and stagger shall also be marked on the mast/structure by a horizontal red painted stroke.
- (5) Numbering of Structures Carrying Overhead Equipment

Structures shall be numbered in accordance with the standard numbering given in the finalized overhead equipment layout plans. Number plates at eye level from a locomotive driving cab (approximate 3m above rail level) shall be provided on each mast or structure. Non retro reflective and retro reflective type number plate shall be used as per RDSO guideline. Details to be submitted for review by Engineer.

- (6) Signage for OHE

Signage shall be provided on steel structures/ standalone boards. All signage shall be retro reflected type in OHE. The locations of signs shall be as under but not limited to:

- (a) Critical locations like before the stop signals and before the permanent speed restrictions.
- (b) Up and Down Gradients
- (c) All other warning boards as per ACTM like DJ (Locomotive circuit breaker) open, DJ close, 500 m board, 250 m board, danger board, brake testing board, overhead crossing board etc.
- (d) Sigma strip shall be provided in fog prone area on two masts prior to all signal locations for easy identification during foggy weather
- (e) Other unusual locations
- (f) Guidelines for numbering contained in clause 3.31 of ACTM Vol. II shall be followed. The proposed location shall be approved by the Engineer.

8.14.5 Construction design shall include the Construction Employment Schedules for structures and the foundations for different situations of loading expected to be encountered on the route.

8.14.6 Field work shall only be commenced when the Contractor has received a letter of no objection to the proposed mast and foundation designs and construction methodology from the Engineer.

8.15 TOLERANCE IN ERECTION:

1.	In Span Lengths shall not vary more than	+/- 200 mm
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2.	Cumulative error in all spans in one km shall not exceed	+/- 1000 mm
3.	Height of Contact Wire	+ 20 mm
4.	Dropper Location	+/- 100 mm

8.16 OUTDOOR STEEL PARTS

The zinc coating for steel structures and parts shall be as per RDSO Specification no. ETI/OHE/13 (4/84) (latest) and all outdoor steel parts used in all applications shall be galvanized.

The Zinc coating specified in the equipment specification, if any, will also be considered and most stringent Zinc coating out of the two will be applicable as approved by the Engineer.

The polluted areas shall be identified as a result of pollution mapping by the contractor and approved by the Engineer, where the zinc coating shall be 1000 gm/ m². In case of need to use nonstandard SPS at special locations to be fixed to the steel structure, these shall be with clamps to avoid drilling of galvanized mast sections.

8.17 ANTI-CLIMBING GUARDS, SAFETY SCREENS, WARNING /DANGER SIGNS etc.

- 8.17.1 Anti-climbing guards shall be provided for all structures supporting Auxiliary Transformers.
- 8.17.2 Screens and anti-climbing guards shall be provided on OHE supports at locations where any person can either touch or gain access to live overhead conductors, such as the signal posts located near live conductors.
- 8.17.3 Where deemed necessary the equipment and critical points shall be clearly identified with warning and danger signs positioned at appropriate intervals, distance and heights.
- 8.17.4 All safety critical items shall be secured by bolts, clamps, etc., and shall be fitted with vibration and shock proof, self-locking washers or secured with split pins behind the nuts.
- 8.17.5 The device shall be clamped to the structure that it protects, and no drilling of the structure shall be acceptable.
- 8.17.6 The anti-climbing guards shall be positioned to allow unimpeded access to maintenance staff during the normal course of their duties.
- 8.17.7 All steel items shall be galvanized.

8.18 INSULATORS AND SECTION INSULATORS

8.18.1 Insulators

- (1) Selection of insulators shall be based on the tropical environment. Composite polymer insulators of longer creep-age path shall be used at locations subjected to level of pollution in the zone and also at Level Crossing Gates.
 - (a) For this purpose, the Contractor shall undertake a survey, tests and a pollution mapping study to categorize levels of pollution level along the route in order to provide insulators suitable for the level of pollution in the zones, structure protection and other protective measures for the OHE. The governing specifications to determine the level of pollution for Insulation and corrosion resistance shall be EN 50119.
 - (b) The insulators selected shall be Maintenance free with higher Creepage distance and long life and should not require any cleaning. *The minimum creepage distance of insulators for TSS/SP/SSP and OHE/ROCS works shall be 31mm/kV.*
 - (c) All insulators shall be, anti-tracking, solidly bonded with weatherproof seals to appropriate end caps.
 - (d) Porcelain insulators as per RDSO Specifications No. TI/SPC/ (OHE)/ INS/0071 shall be provided at all locations except at polluted locations and LC Gates where insulators as per RDSO Specifications No. TI/SPC/(OHE)/ INSCOM/1071 shall be used. The locations where polluted zone type of insulators is to be installed shall be proposed after survey and shall be installed with the approval of the Engineer.
 - (e) For new cantilever assemblies, approved under cross acceptance criteria as per clause 8.10.1, the composite type insulator for cantilever can be proposed for the approval of Engineer, if the same is part of the cantilever assemblies approved under cross acceptance criteria.

8.18.2 Section Insulators

- (1) The Section Insulator (SI) is a device installed in the contact — catenary wires system for electrical separation of two elementary electrical fields while allowing for the passage of a vehicle pantograph, such as in a cross over between two adjacent tracks. The SI shall consist of an insulator located in the catenary wire above an insulator located in the contact wire immediately below it. The contact wire insulator is designed to allow passage of the loco-pantograph across it. To ensure continuous current collection during the pantograph passage, the most commonly used SI contains a side runner located on each side of the unit: the siderunner overlap.
- (2) Section insulators shall not be installed in main line equipment. These shall operate at the required speeds in either direction.
- (3) The section insulator shall be compatible with the mechanical and electrical characteristics of the contact wire, and the system power and electrical clearance requirements for the overhead contact system.
- (4) Type test validation shall be required for the section insulators proposed for the contract.
- (5) The section insulator offered by the Contractor shall be light weight of a Latest design with proven performance in mechanical, electrical and environmental conditions as specified in these specifications. The section insulators shall be

designed to withstand arcing caused by the passing of pantographs with no reduction in mechanical and electrical integrity even if a pantograph runs into an isolated section for a period of three (3) seconds.

- (6) The governing specifications for the electrical and mechanical testing requirements for insulators shall be according to EN50151, IEC 61109 and EN50119.

8.19 DESIGN OF NEUTRAL SECTIONS

- (1) Neutral Sections (NS)/ Phase breaks are insulating units installed in the OHE System that achieve electrical phase separation while allowing physical continuity of the contact wire for the passage of a pantograph. The Phase Break is used to separate different over-head electrical phase sections.
- (2) NS are located away from passenger stations, signals or any location where a train may stop, as the train must coast through the phase gap at a reasonable speed of optimum operation.
- (3) The neutral sections shall be short PTFE type conforming to RDSO design.
- (4) The location of neutral section for the TSS, SP is to be judiciously selected such that trains are able to coast through the TSS and SP with power off with least risk of stalling. Neutral section shall be provided in a tension length not exceeding 600 metre and one end of tension length shall be FTA.
- (5) Accordingly, their location shall be subject matter for interface coordination with the civil works. The track alignment Drawings and station layouts may be carefully examined and location of Neutral sections proposed accordingly and coordinated with Civil contractor. The neutral sections on connection to IR should be as close to IR as feasible.

8.20 EARTHING AND BONDING SYSTEMS FOR OHE and STEEL STRUCTURES

- 8.20.1 The contractor shall develop Earthing and Bonding Management Plan with measures to connect all the structures/ buildings in proximity of Track system and provide low potential earthed rail system including the provision of the Earthing stations, Earth mats, AEW, BEC (if required). The Contractor shall demonstrate through calculations the rail potential rise within the prescribed limits during stringent fault conditions as specified in EN 50122-1.
- 8.20.2 The Earthing, Bonding and Safety system design shall provide the means to carry electric currents into the earth under normal and fault conditions, without exceeding any operating and equipment limits, without thermal degradation or mechanical breakdown and without adversely affecting continuity of service. Earthing & bonding should create a conductive path that shall achieve potential equalization of the grounded elements of the railway system.
- 8.20.3 Adequate Bonding shall be designed and installed throughout the entire electrified route to provide return circuits for the normal traction power currents as well as fault current as may be witnessed during the broken rail or Rail Maintenance without raising the touch potential and compromise to the safety of General public or Rail personnel in proximity/ touch. The contractor shall demonstrate the potential rise in all possible OHE/Power fault case scenarios remains lower than the permissible limit at any point

as per relevant standards including step and touch potential while on going discontinuity in Rails unnoticed like hair cracks etc. and discontinuity of AEW due to failure/theft if any in two independent systems.

8.20.4 Work shall be taken up according to the approved Earthing & Bonding Plan prepared by the contractor and shall include as under:

- (1) Survey and tests for soil resistivity as required for earthing requirement,
- (2) Provision of earthing stations and earth mats to limit the step and touch potential,
- (3) Connection with running rails, Masts, AEW and BEC (if required),
- (4) Connection to Buried rail at TSS, SSP, SP,
- (5) Separate and Distinct Earth Station for Lightning Arrestor,
- (6) Passing of the return current through mass of earth,
- (7) Provisions of return current cables,
- (8) Grounding interconnection,
- (9) Grounding (Earthing), Bonding and Safety provisions of all items, equipment & sites which include OHE structures, auxiliary transformers, all switchgear, buses, cables, feeders, equipment enclosures, associated buildings and other fully or partially conducting items likely to come in contact with rail systems personnel, rail users and general public.
- (10) The OHE mast/portal shall be grounded through interconnections of the mast to the AEW so that the ground resistance of the interconnected masts is kept low. RCC and anchor bolt foundations, where the concrete is in good contact with the adjacent soil, are recognized as being good earth electrodes. But where the ground resistance of individual masts exceeds 25 ohms, individual ground rods or other grounding solutions shall be applied by the contractor.
- (11) Contractor shall connect Earth electrodes, mast/portal structures, and running rails of both the tracks at regular intervals, as per result of simulation study, but such connection interval shall not exceed 400 metres. Contractor shall keep the rail touch and step potentials under acceptable limits both for normal and fault conditions.
- (12) Ground connections to disconnect switches and ground leads from surge arrestors, shall have a maximum ground resistance of 5 ohms. Ground rods or a ground mat may be used to obtain the required ground resistance.
- (13) All metallic equipment & structures shall be connected to the grounding network.
- (14) Survey and implementation of EMC/ EMI mitigation measures including earthing and Bonding limit induced emf within permissible limits on adjoining Electrical, Signal & telecommunication and any other installation.
- (15) Contractor shall furnish a certificate to the Engineer to this effect to have complied all earthing and bonding requirements prior to commissioning of OHE.

8.20.5 The work includes the earthing and bonding of steel work.

- (1) Connectors, Clamps and lugs shall be bolted to structures with bolts, washers& lock nuts.
- (2) Earth Electrodes: shall be at least 1.5 m away from any structure so as not to interfere with its foundation. Each mast/portal/TTC of OHE shall be connected to 3.0 m long copper clad steel rod buried in the ground 300 mm below the NGL through GI flat and fasteners.
- (3) Connectors: Exposed and buried earth connections shall be of type and in conformity with IS 3043-- Code of practice for earthing.
- (4) The earthing connections shall be through fasteners for exposed connections or shall use exothermic welding procedure.

8.21 RETURN CURRENT CONNECTIONS FOR Auto Transformer (AT)

- 8.21.1 The Traction return Circuit constitute a network of Rail, Negative feeder, AEW, BEC (if required), and interconnection between rail and then including Buried Rail to AT.
- 8.21.2 Return Current passing through the rails to the AT shall be routed through the buried rail at each location of Auto Transformer.
- 8.21.3 For this purpose, a steel rail (one being used for track) of minimum of 52 kg/m, length of 13 m shall be buried near the track at the above locations at a depth of about 1 m to form a part of the earthing system. The buried rail shall also be connected by means of at least two separate distinct connections made with steel armoured PVC insulated cables of adequate size to the traction rails. In cases where the feeding post is located separately, away from the traction substation, the buried rail shall be provided at the feeding post (where the midpoint of the auto-transformer winding at the substation is grounded). The connections shall be maintenance free, self-gripping type. Wherever, such bonds pass along or across the tracks, it shall be routed along the sleepers using proper fasteners and clamps so as to avoid any damage/disconnection during ballast screening or tie-tamping of the track.

8.22 Rigid Overhead Conductor System (ROCS)

8.22.1 Design Parameter

(1) Type of overhead conductor system

The Rigid Overhead Conductor system shall include 25kV High Rise AC overhead rigid conductor rail with contact wire, associated jumpers, support structures insulator and ancillary equipment.

(2) Clearances-- Minimum Electrical and Mechanical Clearance

The minimum electrical and mechanical clearances shall not be infringed under the worst operating conditions of the overhead line equipment, the rolling stock and pantograph.

Minimum Electrical and Mechanical Clearance (mm)

Item	Normal inside Tunnel (mm)
25kV Live metal to earth	
static	250
Dynamic (passing)	200
Phase Difference (50 kV)	
Static	540
Dynamic (passing)	350
Gap at Insulated Overlap or air- gap on rigid OCS between conductors of different electrical sections	400
Gap at Uninsulated Overlap or expansion joint on rigid OCS	200

The minimum clearances inside the tunnel for 25 kV traction are those specified in IEC 60913 with latest amendments.

The values shown in the Table above shall be used as a minimum. In the event of additional space being available, the space shall be used to enhance the electrical clearances above the stated values, before consideration is given to increase the system height.

(3) Rolling stock

Maximum height of rolling stock *shall be as per IRSOD-2022.*

(4) Height of rigid conductor rail contact wire

Minimum Height of the contact wire shall be *7220 mm* from rail level.

(5) Stagger of rigid conductor and contact wire

Stagger of rigid conductor contact wire shall be limited to 200 mm, from rail centre on tangent track. On curves, value of stagger shall be submitted by Contractor based on pantograph profile. The design of ROCS shall permit a displacement of track by 50 mm horizontally without need for changing any component.

(6) Permissible gradient of contact wire

Gradient of contact wire shall be not more than 1mm/m on main tracks and not more than 2mm/m in loop lines.

8.22.2 Supporting structure

(1) **Safety of supporting structure**

Supporting steel structure for overhead contact system shall have a safety factor not less than 3 times the yield strength of steel against dynamic operational loads. *All steel structures of ROCS in Tunnels shall be hot dip galvanized as per RDSO Specifications No. ETI/OHE/13 (4/84) (latest) with minimum galvanization of 1000 gm/sqm.*

(2) **Anchor plug and anchor bolt/ Chemical fasteners of supporting fixture.**

Anchor bolt shall be installed for the supporting fixtures of rigid conductor rail at intervals finalized on basis of detailed design. The type of bolts and chemical fastener shall also be finalized on basis of detailed design. The supporting fixtures shall have facility of adjustment so as to install the ROCS at the designed height with the requisite stagger of the conductor rail. Yielding point strength of the fixtures and fitments shall have adequate factor of safety, considering worst loading/torsion conditions and dynamic loading on account of pantograph thrust and movement. The Contractor shall furnish the supporting design details for approval of the Engineer. *Grouting shall be designed with a factor of safety as 4 and shall be load tested at design load for all the anchor bolts.*

(3) **Supporting steel fixture**

The supporting steel fixtures (Drop Tube) shall be provided at suitable intervals, which are fixed to the tunnel ceiling by anchor bolts, based on design consideration. The interval between successive fixtures shall not permit undue sag and vibrations. The sag shall be less than 12 mm in the conductor rail span (RDSO Instruction No. TI/IN/0041, September, 2022 : Guidelines for ROCS for use in tunnels). The contractor shall furnish the supporting data of similar systems, which may have been provided by the contractor on other Railway Tunnel System/Metro System with 25kV AC rigid OCS, for the same speed potential. The steel work shall be hot dip galvanized and the nuts, bolts and washers shall be G.I./stainless steel of suitable grade for moist and polluted tunnel atmosphere.

(4) **Support Insulator**

Type of OCS support insulator to be provided shall be proven and shall meet the CAC. The electrical and mechanical properties of support insulator for the 25 kV High Rise AC rigid conductor shall be in accordance with the recommendations of IEC 383 / 1109. The minimum creepage distance of the insulator shall be 1100 mm, wet power frequency withstand voltage shall be 110 kV and dry lightning impulse withstand voltage shall be 250 kV in accordance with the recommendations of IEC 60913. The mechanical design should be proven to take the flexural stress to support the design. Supporting insulator fixture shall permit free sliding of Rigid conductor to allow for expansion on account of temperature changes.

(5) **Standoff Bracket (cross arm)**

This component is attached to the insulator through nuts and bolts. It is also known as cross arm. This has a long slot inside which provides the required stagger of ± 200 mm from the track centre axis. The length of the standoff bracket varies as per the requirement or site conditions. Like in case of overlaps, since parallel CRs are installed, the length of standoff bracket is lesser than the normal. Standoff bracket is always live.

(6) Swivel Head

This is provided in the slots of standoff bracket and can slide in the slots to achieve stagger of ± 200 mm. Its main purpose is to hold CR and this allows free movement of CR due to temperature variations.

(7) Preventing loosening of nuts and bolts

Adequate measures shall be taken for preventing all bolts and nuts from becoming loose, by use of lock nuts/ spring washers.

8.22.3 Expansion Joint

Typical arrangement and Interval between expansion joints.

Expansion joints shall be provided at suitable intervals but the maximum interval may be allowed up to 500m depending upon the site condition.

(1) Parallel contact wires at expansion joint

Parallel contact wires shall be of adequate length to provide for suitable expansion joint assembly with provision for adequate number of flexible continuity jumpers. Separation distance between two ROCS sections at expansion joint shall not be less than 200 mm to ensure smooth passage of pantograph. No expansion joint shall be provided in the station area. Suitable gradient will be provided to ensure smooth change over. The expansion joints may be erected at site or prefabricated from the manufacturing works.

8.22.4 Sectioning Equipment

(1) Air-gap section

The structure of air-gap section shall be same as that of an expansion joint. At insulated air-gaps, separation distance between two ROCS sections at the overlap shall not be less than 400 mm, with two ROCS sections aligned such that pantograph passes satisfactorily. Air-gap sections shall be provided at the crossovers to segregate two sections. In case air-gaps are not found practicable, only in exceptional circumstances, the section insulators may be permitted.

(2) Jumper wire for rigid conductor

Jumper wires for rigid conductor shall be of stranded annealed copper with adequate current carrying capacity. Connection of jumper wire to rigid conductor rail shall be through suitable bimetallic terminals each having at least two fixing

bolts. Bolts shall not conduct any current. Jumper wire shall be flexible to allow creeping of rigid conductor. The design shall ensure that the jumper loops remain at least 75 mm above the contact plane. The capacity of ROCS jumper wire shall be the same as that of the capacity of jumpers for flexible catenary and contact wire so as to flow transmission of full power. Jumper sizes and current carrying capacity shall not be less than as mentioned in RDSO Instruction No. TI/IN/0041, September, 2022 : Guidelines for ROCS for use in tunnels.

(3) Anchors

Anchors shall be provided for prevention of unidirectional creeping of rigid conductor rail.

(4) Location of anchoring

Anchoring shall be provided in the middle of one conductor run length between two expansion joints.

(5) Anchoring Insulators and Hardware

The design shall be such that the Insulator and hardware used at anchoring location shall be least affected by passing pantographs. Materials for anchors shall be corrosion resistant such as hot dip galvanized or of stainless steel. Suitable bimetallic fitment shall be integral with the hardware to prevent electrolytic corrosion to aluminium.

(6) Rigid conductor rail and contact wire

- (a) Conductor rail shall be of Aluminium alloy section with wearing copper contact wire. Sections of conductor rails shall be joined together to form lengths up to 500m between two consecutive expansion joints. Contractor shall submit calculation of conductor length expansion for Engineer's approval. Contractor shall furnish the details of the conductor rail system offered indicating the life, speed potential of installation, strength and conductivity of joints, maintainability and the supporting details including performance of similar rigid conductor systems, if provided by contractor, on any other metro/Railway system. The lower side of the Rail has ribs on both sides for the contact wire insertion device which is used for inserting contact wire into conductor rail. To avoid bimetallic corrosion, the conductor rail profile design must not allow any condensation water to trip along profile and come in contact with copper profile interface. Contact wire is inserted inside the conductor rail profile and it is not mechanically tensioned.
- (b) The copper Contact Wire shall be Hard Drawn Grooved Round Bottom, 150 sq mm area and material shall have temperature withstand capacity minimum 100⁰C as per EN50119 and conforming to EN50149 or RDSO Specification No. TI/SPC/OHE/CW/0971 (latest).
- (c) As Aluminium Alloy conductor rail will come directly in contact with the Copper contact wire, contractor will provide the mitigation measures to eliminate bimetallic/galvanic corrosion of conductor rail.

8.22.5 Standard length of conductor rail system and interlocking joints

- (a) Standard length of conductor rail is generally around 10 metre. The span length of conductor rail shall conform to RDSO Instruction No. TI/IN/0041 of September,

2022 (Guidelines for ROCS for use in tunnels). However, the length offered by Contractor shall be supported by the calculations and the data of various metro systems using similar/same size rigid conductor OCS for the same speed potential.

- (b) Interlocking joints are used for interconnection of two conductor rails. Interlocking joints are made up of same alloy as that of conductor rail and have similar physical properties. These rails are made continuous by Splices/Rail Joints. The conductor Rail (CR) Joint consists of inner and/or outer plates. The plates with their large contact surfaces ensure the current transmission between the rail and the joint and are also used for accurate mechanical fixing and fastening of the conductor rail. The interlocking joints have screw connections on each plate which allows faster construction and repair.

8.22.6 Protection cover for rigid conductor rail

Conductor rail shall be provided with a protective cover in the entire ROCS length. The material of protection cover shall be Fire Retardant Low Smoke, Zero-Halogen (FRLSZH).

8.22.7 Transition from Rigid to Flexible Catenary System

The transition from flexible overhead catenary system to Rigid overhead conductor system in the tunnels and vice versa shall be so designed that passage of the trains is as smooth as possible without resulting in any pantograph jerk, sparking and wear of components. The cross sectional area of copper (current carrying capacity) to remain the same throughout the installation. The design should be a proven design and should satisfy CAC. It is arrangement of joining ROCS with flexible OHE whenever track enters into underground tunnel or vice-versa. At the junction point of flexible OHE and the ROCS system, there will be a sudden change in the stiffness of the contact wire. The flexible OHE contact wire is tensioned but not rigid; whereas the contact wire of ROCS is not tensioned but clamped in rigid Conductor Rail. Thus, the movement of pantograph may not be smooth during the transition from flexible OHE to ROCS or vice versa due to this sudden change in the contact wire stiffness. Hence, there shall be a gradual equalization of the difference in stiffness between the flexible OHE contact wire and the ROCS contact wire to assist a smooth transition of pantograph. This is achieved by using the transition bar at the junction point. Transition bar is a piece of Conductor Rail with cut outs and these cut outs provide more flexibility and the transition bar acts as a shock absorber. At the junction point between flexible OHE and the ROCS system, the tensioned contact wire from Flexible OHE enters the ROCS system through the transition bar & anchor bar and gets terminated inside the ROCS system. The anchor bar is a normal conductor rail section only but it is provided with a number of bolts. The anchor bar is followed by the end point anchor arrangement. The endpoint anchor takes the tensile force of the contact wire entering the conductor rail and leads it into the civil structure. Thus, with the exception of the transition section, the contact wire in the conductor rail is not subjected to tensile forces. Contractor to design the transition arrangement and submit for approval of the Engineer.

8.22.8 Feeder for power supply to conductor Rail

A feeder cable (or flexible OHE wire) to supply power at 25 kV to from OHE to Conductor Rail (CR) and vice versa is required at the tunnel points. These 25 kV cables conforming to IEC-60840 are connected for transmission of power. At each CR joining point 2x240 sqmm copper armoured cables are terminated on copper busbar mounted

on an insulator and then 4x150 sqmm copper jumpers are connected to Conductor Rail. Contractor to design the system for review of the Engineer.

8.22.9 Indicators Boards

- (1) ROCS section indicator Boards shall be provided at approach to each electrical section of ROCS, which shall be visible to Train Operators (Drivers/Loco pilots) from an adequate distance.
- (2) Number plates shall be provided at support locations, the numbering scheme to be adopted shall be submitted for review of Engineer.
- (3) Warning indicator Board shall be provided at approach to termination of contact wire..
- (4) "Warning: 25kV AC " Boards shall be provided at locations and intervals as decided upon by the Engineer. These boards shall be prominently displayed at regular intervals.

8.22.10 Earthing Clamps

Wedge type PG clamps to be used for Earthing & bonding connections.

- (1) **Earthing Clamp**-- For maintenance activity on ROCS, discharge rods are connected on ROCS at the both ends of the section where work has to be done to ensure that the system has been completely grounded and no charge exists on the rigid conductor system. The other end of the discharge rod is connected to the track rail or nearest earth point. Earthing clamps are fitted on the CR at the both ends of a tension length. These clamps provide proper fixing for the discharge rod. Discharge rod cannot be fitted anywhere directly on the conductor rail.

8.22.11 Aerial Earth Wire inside the tunnel

Aerial Earth Wire (AEW) shall run through the tunnel and contractor shall make proper mounting on the tunnel wall. All ROCS support brackets shall be earthed with AEW. At frequent intervals (not exceeding 400 m) the AEW shall be connected to the Tunnel Earth Wire (250 sqmm steel conductor).

8.22.12 Negative Feeder Wire inside the tunnel

Negative Feeder Wire (NFW) shall run through the tunnel. This shall be mounted on the tunnel wall with proper arrangements. Necessary clearances from tunnel wall and ROCS shall be maintained. The terminations shall be suitably designed with proper anchoring arrangement. The distance between the two mounting arrangements shall be such that NFW shall always remain above the contact wire of ROCS. The design shall be submitted for review of Engineer.

8.23 ROCS Contractor's Design Responsibility

8.23.1 Detailed Design of the ROCS

- (1). Based on the survey of entire route, the Contractor shall offer the most suitable ROCS profile including ROCS sectioning and work out in detail the ROCS construction plan including return current longitudinal (continuity) and transverse (equalizer) bonding plan.
- (2). The above application designs shall be based on standard arrangement Design principles and specially for:

- a) OCS supports and spans, adequate common parallel run at expansion joint.
 - b) Arrangement of jumper connections at expansion joints and at feeder connections.
 - c) Transition arrangement with flexible OHE to be such that area of X-section remains the same throughout this section.
 - d) The insulator and OCS fittings must be able to take the flux stresses to accommodate train at design speed.
- (3). (a) The components and fittings shall be of type and metallurgy, which are rust and corrosion proof. Steel components shall be hot dip galvanized . Nuts, bolts and spring washers shall be suitable grade stainless steel.
- (b)The fittings, jumpers etc shall need minimum maintenance. Insulators suitable for humid and urban polluted atmosphere shall be used. The insulator shall be oil resistant and the surface finish should be such that least amount of dust is able to accumulate on the insulator surface.
- (c) The design shall be coordinated fully with the requirements of the signalling and telecommunication system, final track work, tunnel work, lighting system and any specified design requirements that those systems or facilities may dictate for the operation and management of the services.
- (4). The Contractor may engage specialist subcontractor for ROCS work as per details given in Appendix-13 of GS.

8.23.2 Submittals

(1). Basic Design

Based on the basic designs worked out and route survey, the Contractor shall prepare and submit a detailed OCS final design, together with hardware applications design appropriate for the whole Project. The design of the support and anchor assemblies shall ensure adequate clearance from the pantographs under dynamic conditions. The Contractor shall select full range of proven ROCS components, and shall demonstrate by means of engineering calculations that all elements of the selected system are capable of meeting the Design Criteria, Safety, and Operational requirements. When computer programs are proposed for use, the Contractor shall submit typical hand calculations, together with comparable computer data input and output, for verification of the program, together with a description of the software.

(2). Drawings for review

Construction drawings shall be prepared and verified at site. The site verified plans shall be submitted to the Engineer for review. These shall include but not be limited to:

- a) Schematic sectioning Diagrams.
- b) ROCS construction Plans.

These shall include chainage of all support anchors and air gaps, height over rail level and other general particulars. On-site verification of the plans shall be carried out and based on final construction plan. OCS layout shall be finalized for construction.

c) ROCS layout plan:

Based on the finalised construction plan, ROCS layout plan shall be developed and submitted for review by Engineer. The ROCS layout plan incorporating following information shall be submitted:

- i. The alignment of the conductor.
- ii. Chainage of each support structure location.
- iii. Exact chainage of all expansion joints, anchors and air gaps.
- iv. Direction and value of stagger at each location.
- v. Clearance of live conductors to fixed structures with respect to reference chainage.
- vi. Alignment and layout of feeders.
- vii. Jumper connections to switches and feeder tails.
- viii. List of infringements, if any.
- ix. Numbering of each support structure with respect to reference chainage
- x. Location and serial number of isolator switches.
- xi. Final Sectioning diagram drawn to a convenient scale showing identification number of section insulators and elementary sections.
- xii. Transition Element drawing (from Rigid OCS to Flexible OHE).

d) ROCS profile drawings

In case the height of contact wire is changed, an ROCS profile drawing showing the actual height of the contact wire at each location and the gradient adopted until normal height of contact wire is achieved.

e) As Built Drawings

Preparation of As-Built Drawing shall be part of this specification. As Built Drawing will be Final Drawings of the project showing the actual work done on a scale appropriate for the level of detail readily visible for review by the Approver. Normally part plans shall be prepared at A1 sheet and full scale plan A0 sheet.

8.23.3 Construction Requirement

(1). Track route and layout inspection and preparation of installation work

As preparatory work prior to installation, the location and position of supporting fittings, rigid conductor rail and anchoring shall be verified and marked at site. Height of the tunnel from top of rail at various locations shall be confirmed.

(2). Installation of supporting structure

(1) Supporting structure

Supporting anchor bolts shall be supplied and installed by the Contractor.

(2) Supporting Insulator and accessories Supporting insulator and accessories for rigid conductor rail shall be mounted on supporting structure to enable adjustment of the conductor to required stagger as per the final design drawings.

(3) Installation of rigid conductor and contact wire.

Care shall be taken that no breakage, dent, crack or bending of any component takes place during transportation. Adequate care shall be taken to prevent any damage due to rust by applying rust prevention paint. Painting schedule to be submitted for review by Engineer. Materials delivered at work site shall be laid up neatly at nominated locations so that interference does not occur from other works going on nearby.

(4) Installation of rigid conductor rail and contact wire

Due care shall be taken while handling the rigid conductor rail that no twisting or bending or development of any crack takes place. Temporarily supporting the rail with one end cantilevering shall be prohibited. While installing the rigid conductor rail, safe practices shall be adopted. The erection of conductor rail shall be commenced from the anchor structure and continued on to the expansion joint. Before installation of the end approach of expansion joint, adjustment of final length shall be in accordance with the measured temperature in the tunnel. On curved track, the conductor rail lengths appropriately bent, with the approval of the Engineer, to requisite curvature taking into account track conditions and deviations of contact wire shall be provided. On turnouts the level of the crossover contact wire shall be raised so that it does not come in contact with train pantographs running on the main track, and for the trains negotiating the turnout, the passage and current collection by pantograph is smooth. Adequate tensile force shall be maintained in the contact wire. The Contractor shall submit the OCS installation plan to Engineer for approval.

(5) Jointing the rail

If the rail lengths are bolted together, the bolting process shall be of proven design with use of proven components.

(6) NFW mounting in tunnel and AEW clamping with tunnel.

8.23.4 Final Adjustment and Measurement of ROCS

After the equipment has been finally adjusted, the equipment shall be subject to final measurements jointly with the Engineer. The checks shall include but not be limited to:

- a) Support location member, its height above rails level and stagger, gradients in ROCS.
- b) Contact wire height at mid span between successive support members.
- c) Anchors, expansion joints and air gap separations.

- d) Clearance checks to ensure pantograph passing clearances, both electrical and mechanical clearance Pantograph test to ensure smooth shock free passage especially at section insulators at air gaps, at turnouts, crossovers and change of height of the contact system.
- e) Fittings or jumpers and cable connection to:
 - (i) Overhead conductor rail
 - (ii) Return current circuit connected to running rails at regular intervals.

8.23.5 Site Testing and Inspection

- (1) A detailed protocol for inspection and testing of complete ROCS shall be prepared and the tests and complete methodology for testing shall be submitted for review by the Engineer.
- (2) **Installation checks and tests**
 - a) Visual inspection of overhead contact system installation, random check of components; electrical and mechanical clearances, air gaps and general alignment.
 - b) Continuity test of each joint in traction and return current circuit.
 - c) Insulation resistance of 25 kV ac overhead contact system shall be as per international standards.
 - d) Physical examination of rail bonds.
 - e) Checking of construction gauge
 - f) NFW continuity test, testing of joints.
 - g) Earth resistance test.

8.23.6 System Acceptance Tests

(1) Energisation

Each electrical section shall be energized successively at 25 kV AC from for one minute with adjacent sections isolated and connected to traction earth. Finally, entire section shall be energized for at least 24 hours.

- (2) Short circuit tests shall be carried out as per a detailed test protocol, which shall be submitted for review by Engineer.

8.23.7 Integrated Testing and Commissioning

- (1) All the items of supply and required for completion of the work in all respects, testing and commissioning of the OHE system as well as associated works and ROCS, for facilitating trial run of the rolling stock and Integrated Testing and Commissioning shall form part of the work covered by the contract whether specifically stated or not.
- (2) During train trial contractor shall be responsible for providing and fixing discharge rods during power block permission/Cancellation before Revenue operation.
- (3) High speed tests shall be carried out by means of running the trains initially at slow speed, then increasing the speed in stages up to full speed permitted for the

section. On successful completion of the high speed tests, the ROCS shall be declared fit for pre- revenue system tests.

- (4) The Contractor shall be required to operate and maintain the OCS until Taking Over by the Engineer.

8.24 INTERFACE COORDINATION BY THE CONTRACTOR

8.24.1 Design Coordination and Interface

The Contractor shall be responsible for design coordination for EMI and safety works related to rendering the whole installation safe from EMI interference (including twin tunnels) and from unsafe touch potential from induction effects of AC traction currents with the Civil Contractor and through the Engineer with adjacent DFCCIL and Indian Railway system of both electrified and non-electrified sections, if any.

- (1) The Contractor shall be responsible for coordinating the final OHE & ROCS design and installation at different stages of design and construction in co-ordination with Civil and S&T contractors.
- (2) The Contractor shall be responsible for Interface with the DFCCIL and Indian Railway.
- (3) The Contractor shall also interface with Indian Railways (IR) through the Engineer as follows:
 - (a) For the design, construction, testing and commissioning of the overhead line at the Stations linking with IR. .
 - (b) To ensure that the design and construction of the OHE does not affect the signal sighting on Indian Railways.
 - (c) To ensure that the construction of the OHE does not interfere with train operation on Indian Railways nor damage any Indian Railway assets.
 - (d) To ensure that the design and construction does not impede the operation and maintenance for Indian Railways, in any way.
- (4) The contractor SYS-1 shall provide protective screens for works like new/extension of ROB/ FOB etc along with earthing and various warning & danger Boards. The Contractor shall interface and coordinate with the civil contractor regarding progress of ROB/FOB etc. The contractor shall also coordinate with civil contractor for removal of trees from any work site of TSS/SP/SSPs which shall be removed by the Civil contractor.
- (5) The contractor shall coordinate with Civil contractor for Connection with Rail ensuring smooth flow of traction return and fault current back to TSS from the bridges and for ensuring safe touch and step potential under all conditions and shall execute all the necessary works.
- (6) Contractor shall coordinate with civil and S&T (signal and telecommunication) contractor regarding construction of Level Crossing LC). The Height Gauge at LC gates shall be installed by the Civil Contractor along with provision of warning and danger boards and their earthing. Contractor shall interface with civil contractor for provision of warning and danger boards etc.

8.24.2 Tunnel works interface

Contractor shall interface with civil contractor for all tunnel works i.e provision of ROCS support steel fixtures, AEW and NFW mounting, protection screen on Conductor Rail etc.

8.24.3 The interface requirements to be met by the contractor have been defined in chapter 18 of these Specifications.

(End of Chapter 8)

CHAPTER 9—LV SUPPLY AT TRACTION SUPPLY POSTS AND S&T INSTALLATIONS FROM 25KV/240V AUXILIARY TRANSFORMER

9.1 GENERAL

240 V, single phase, LT power supply for Switching posts and Stations and for other S&T installations shall be through Auxiliary Transformers.

9.2 SOURCE OF SUPPLY

240V, single phase, LT supply at TSS, SP and shall be obtained by suitably installing 25kV/240V, single phase auxiliary transformer of the following rating:

- (1) TSS (each) — Two 100kVA Auxiliary Transformers connected to 25kV bus bar.
- (2) SP and SSP — One 25 kVA Auxiliary Transformer on UP line and second on DN line at each switching station connected to 25kV bus bar.
- (3) The connection shall be such that in case of power block or failure of power supply on any one of the lines, the LV power shall automatically switch over to the other line.

9.3 LV SUPPLY AT STATIONS AND S&T INSTALLATIONS

- 9.3.1 The emergency power shall be made available for essential loads by the contractor by installing 25kV/240V, Single Phase, 50 kVA auxiliary transformer at 4 nos. junction and 8 nos. crossing stations and 25kVA (minimum) step down transformers at other 6 nos. stations. The LT cabling from the auxiliary transformers shall be terminated at the automatic change over switch located in Station as required. The connection for such emergency supply shall be arranged as per the requirement for various station / Rooms.
- 9.3.2 For Telecom installations and LC gate along the route, supply from 25kV/240 V, Single phase (10 kVA minimum) Auxiliary Transformers, shall be the main source of supply and shall be provided by the contractor including laying of LT cables and provision of Automatic Changeover (ACO) switch. The connection for such emergency supply shall be arranged as per the requirement for various equipment Rooms. The Cable crossing required (if any) under the track shall be suitably protected through conduits / pipe as stipulated in ACTM and track crossing regulations. The Contractor shall provide the same in coordination with the Civil Contractor.
- 9.3.3 The Cables shall be laid from the output of secondary side to the Automatic change over switch (ACO) installed in the ASM's room or Telecom huts in the Prithla – New Harsana Kalan section.
- 9.3.4 The auxiliary transformer losses shall not exceed as per specified criteria of BEE for 5 – star rating.
- 9.3.5 The Auxiliary Transformers shall conform to specification no. ETI/PSI/15(8/03) and mounting arrangement shall be similar to ETI/PSI/0312 (Mod. B). The efficiency of the auxiliary transformer shall be governed by the total losses at 50% and 100% loading as per the formula given below:

$$Y_{050\%} = \frac{(K_{X_0} \% \text{ and})}{(K_{X_2} \% \text{ and})} X((L_2 - L_1) + M_1 X_1)$$

$$Y_{0100\%} = \frac{(K_{X_0} \% \text{ and})}{(K_{X_2} \% \text{ and})} X((L_2 - L_1) + M_1 X_1)$$

Where :

K = kVA rating of transformer

L = losses

M1 = Maximum losses for a given star rating

X₀ = kVA rating of Standard Rating Transformer

X₁ = kVA rating of Standard Rating Transformer below X₀

X₂ = kVA rating of Standard Rating Transformer above X₀

L₂ = Maximum losses for a given star rating Standard Rating Transformer above X₀@ a particular loading

L₁ = Maximum losses for a given star rating Standard Rating Transformer below X₀@ a particular loading

M₁ X₁ = Maximum losses of X₁@ a particular loading for a given star rating

(End of Chapter 9)

CHAPTER 10–SUPERVISORY CONTROL & DATA ACQUISITION (SCADA) SYSTEM

10.1 GENERAL REQUIREMENTS

- 10.1.1** This Chapter of the Particular Specifications defines the objectives, guidelines and requirements for the Contractor's design, manufacture, supply, installation, testing and commissioning of field side equipment and integration of Supervisory Control and Data Acquisition (SCADA) system for Prithla to New Harsana Kalan section. The Prithla – New Harsana Kalan section wherever mentioned shall also include all the connections of HORC line with IR i.e (1) from New Patli station to Sultanpur station (IR) and Sultanpur station (IR) to Badsa with SP at Sultanpur station (IR); (2) from Mandothi station to Asaudah station of IR with SP at Asaudah station (IR) and (3) New Harsana Kalan to Harsana Kalan station (IR) with SP at New Harsana Kalan station and also connection of HORC line from Prithla to New Prithla station of DFCCIL with SP at Prithla and connectivity of Prithla (HORC) with Prithla (DFCCIL). All the SCADA provision for the entire section shall be under the scope of Contractor SYS-1.
- 10.1.2** The architecture of the SCADA systems and the OCC equipment shall allow to control and monitoring of the traction power supply installations for the Prithla to New Harsana Kalan. Therefore, the Contractor is responsible for Design and Installation of Control and Monitoring equipment including work station in the OCC for the entire section.

10.2 Scope of Works

- 10.2.1** The Scope of works to be executed under this Contract Package SYS-1 includes design, manufacture, supply, installation, testing, integrated testing and commissioning of traction SCADA for Prithla to New Harsana Kalan Section and also switching stations of lines joining IR, are as below but not limited to:-
- (1) Remote monitoring and control of 220 kV TSS,
 - (2) Remote monitoring and control of Traction Substations (TSS),
 - (3) Remote monitoring and control of Sectioning Posts (SP),
 - (4) Remote monitoring and control of Sub Sectioning Posts (SSP),
 - (5) Remote monitoring and control of standalone Auto Transformer Stations (ATS) if required as per traction simulation studies and duly approved by the Engineer,
 - (6) Remote monitoring of power supply status of Auxiliary Transformers (ATs) at all stations (17 nos. from Prithla to New Harsana Kalan and Sultanpur & Asaudah) provided enroute through Traction Power SCADA system. Control and monitoring of motorised isolators of all 17 (Seventeen) main line stations and Sultanpur & Asaudah stations.
 - (7) Remote monitoring and control of switching stations of lines joining IR at Sultanpur, Asaudah & New Harsana Kalan and motorized Isolators at Sultanpur, Asaudah & New Harsana Kalan yard OHE. Remote monitoring and control of switching station of lines joining DFCCIL at New Prithla.
 - (8) Monitoring of above TSS, Switching posts etc which shall include all switches such as Circuit Breakers, Interrupters, motorized Isolators etc,
 - (9) The monitoring includes acquisition of data such as Voltage, Current, kVA, power

factor, Maximum demand, Energy etc. with recording facilities and storage of data for a period of 3-Months time.

- (10) OHE Catenary Indication with auto fault localization and isolation of faulty section with monitoring fault locations as triggered by Fault Locators acting on the algorithm and logics as approved and compatible for reporting to the OCC.
- (11) Monitoring of traction return current shall provide measurement of following:
 - a) The traction return current returning from the Earth (connection between the bus bar and the Traction Power Feeder grounding system), and
 - b) The total return current of each main transformer and auto transformers flowing through the cables between the bus bars and the transformers.
- (12) Provision of control & data cable network and cable containment arrangement at the following locations:
 - (a) TSS, SP, SSP, SS, Auxiliary Transformer locations and ATS if any; and Switching stations (1x25 kV) at 2 locations;
 - (b) Low Voltage AC and DC power supply wiring at TSS, SP, SSP, SS, Auxiliary Transformer locations and ATS if any;
 - (c) All Traction Power SCADA control and power supply cabling within OCC.
 - (d) Where cables cross the track or are external to cable trench routes, then these shall be suitably laid through the Pipes as stipulated in IS 1255, ACTM and track crossing regulations. The Contractor shall coordinate with the other Contractor and provide the same. The Under track crossing conduits shall have a Cable pull pit of size and arrangement as approved by the engineer at both the ends to facilitate cable laying & pulling.
 - (e) Provision of cable termination boxes at RTU locations and at OCC for OFC Cables, where cables enter and leave the equipment room.
- (13) Protective provisions relating to electrical safety and earthing of SCADA equipment which include earthing of equipment, cables and non-current carrying metallic components, etc.
- (14) Monitoring of check metering at TSS to register all the Energy parameters similar to those measured by Power utilities,
- (15) Provision of Web server with appropriate security (Firewall etc.) with capability for internet connectivity for access of HMI (only monitoring) from remote location, as required,
- (16) The Contractor, shall provide OCC equipment (Server and Work Station etc) including adequate redundancy related to various field equipment for Prithla to New Harsana Kalan Section and also for connectivity with Northern Railway (at Patli, Sultanpur, Asaudah and Harsana Kalan stations). The SCADA equipment RTU etc at Patli SP shall be provided by other OHE contractor but all equipment at OCC for control and monitoring of Patli SP shall be provided by Contractor SYS-1.
- (17) The Video wall for displaying the status of equipment at OCC for the Prithla to New Harsana Kalan Section shall be provided by the Contractor under Contract Package-SYS-1. The Contractor shall display SCADA information on Video wall for the entire Prithla to New Harsana Kalan Section and also for connectivity with Northern Railway at Patli, Sultanpur, Asaudah and Harsana Kalan stations.
- (18) The communication link between Substations, Switching Stations, ATs, Stations,

stations and Depot (IMD & IMSD) with OCC through an optical fiber cable (OFC). The provision of OFC for Prithla to New Harsana Kalan Section and for connectivity with Northern Railway (at Patli, Sultanpur, Asaudah and Harsana Kalan stations) and with DFCCIL at New Prithla shall be required. The communication link with OFC shall be provided by Signalling and Telecommunications (S&T) Contractor. The Contractor (SYS-1) shall interface with S&T contractor for ensuring proper telecommunication link, as required.

- (19) The Contractor (SYS-1), shall interface with Northern Railway (NR) for ensuing provision of OCC equipment (Server and Work Station etc) in NR system including adequate redundancy related to various field equipment for switching stations having connectivity with Northern Railway (at Sultanpur, Asaudah and Harsana Kalan stations). Accordingly, the Contractor SYS-1 shall furnish the requirement and I/O List of control and monitoring signals to Northern Railway for successful integration of SCADA System at the OCC of NR. Contractor (SYS-1) shall also interface with DFCCIL for SCADA system integration (between HORC and DFCCIL) for Prithla to New Prithla section.
- (20) The Contractor shall provide RTU and other accessories at 11kV/440V substation or 440V supply system at stations and tunnel for monitoring HTP, MDP, DG set, UPS (as required). There shall be 2 nos 11kV/440V substations for tunnel power supply system.

10.2.2 A comprehensive Scope of works under this present Contract Package SYS-1 for Prithla to New Harsana Kalan Section and the Works related to provision of Control & Monitoring Equipment in the OCC for the entire Section under Contract Package are summaries hereunder. :-

- A) Detailed list of SCADA Equipment in the OCC provided by Contractor shall include but not limited to. :
 - (1) Operator Work stations at OCC for Prithla to New Harsana Kalan Section; and connections at New Prithla (DFCCIL), Patli (IR), Sultanpur (IR), Asaudah (IR) and Harsana Kalan (IR),
 - (2) Data Server, Application Server with 100% redundancy for this section.
 - (3) Separate Communication Server with 100% redundancy for this section
 - (4) All the Servers shall be configured in hot stand-by arrangement with 100% functionality,
 - (5) Training Simulator with minimum 5 no. training consoles at OCC for training of SCADA Operators and maintenance staff. The Training Simulator setup includes minimum Training RTU, Training Server, Trainer Console and Trainee Console.
 - (6) Provision of Network Switches with 100% redundancy at OCC,
 - (7) Provision of hot stand-by server at OCC.
 - (8) The OCC equipment shall be designed, supplied and commissioned for entire Section.
 - (9) The provision of interface hardware for SCADA information for real time projection on Video wall for the entire Section.
 - (10) OCC Equipment
 - (i) Communication and Application Server

- (ii) Workstations for Control and monitoring, Report generation, Offline data analysis, Engineering, Maintenance and RTU configuration
 - (iii) Archive and Webserver
 - (iv) Simulator System for Training
 - (v) Network Security and Monitoring System
 - (vi) Laser Jet and Line printer A3/A4
 - (vii) Communication and dual LAN equipment
 - (viii) Mounting brackets, equipment cabinets, racks, installation materials
 - (ix) Server Room furniture with proper storage for spare material as required
 - (x) Power Extension from the UPS, cables, connectors, accessories, cabling and earthing necessary for the works
 - (xi) Other equipment as necessary to fulfil the requirement
- (11) Detailed list of Field equipment for SCADA provided by Contractor but not limited to:
- a) Remote Terminal Unit (RTU) and associated communication equipment
 - b) Local Interface Unit (LIU) at TSS for Local control
 - c) Cables, connectors, accessories, cabling and earthing necessary for the works
 - d) Portable configuration and Fault Diagnostic devices - One number for each IMD and two numbers for OCC.
 - e) Data Communication Network:
 - (i) The provision of network within TSS, SP, SSP, SS, AT and ATS if any,
 - (ii) The Contractor shall establish the communication network from different Power supply installations for the present section.
 - f) Any other works/equipment to fulfil the specified requirement,

10.2.3 An indicative conceptual system configuration for the SCADA system Prithla to New Harsana Kalan Section is attached in Part 2, Section VII-3 and included in the bid documents.

10.2.4 Emergency Power requirement for calculating Rating of UPS

- (1) Emergency power supply at OCC for SCADA system shall be provided by the Contractor by 2 nos. independent online UPSs.
- (2) Each UPS shall have minimum 120 minute Battery power backup capacity.
- (3) UPS 'Emergency Power supply' for SCADA at Stations, depots as applicable including Control Room Buildings (TSS, SSP and SP) for Traction & Auxiliary SCADA load etc. as approved by the Engineer shall be provided.

10.2.5 The design and installation of SCADA equipment shall be based on this particular

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specification (PS) and based upon best engineering practices and conforming to the following specifications, IEC/EN/ISO/Indian equivalent standards:

[IEC 61508]	Functional safety of electrical/electronic/programmable electronic safety related systems
[EN 50126]	Railway applications – The specification and demonstration of Reliability, Availability Maintainability and Safety (RAMS) [IEC 62278 series]
[IEC 62443-5]	Industrial communications networks – Network and System Security – Security for industrial automation and control systems – Part 5: Technical security requirements for industrial automation and control systems
[IEC 62236]	Railway Applications – Electromagnetic Compatibility
[EN 50121]	Railway applications - Electromagnetic compatibility
[EN 50011]	Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical radio frequency equipment
IEC 61000-4]	Series of standards - Electromagnetic compatibility – Generic standards – Testing and Measurement Techniques
[IEC 60870-2-1]	Tele-Control equipment and systems- Operating conditions – Power Supply and electromagnetic compatibility
[IEC 60870-2-2]	Tele-Control equipment and systems- Operating conditions – Environmental Condition.
[IEC 60870-5-1 to 5]	Series of Standards - Tele-control equipment and systems- Transmission protocols
[IEC 60870-5-101]	Tele-control equipment and systems- Transmission protocols - Companion standard for basic tele-control tasks
[IEC 60870-5-103]	Tele-control equipment and systems- Transmission protocols - Companion standard for the informative interface of protection equipment
[IEC 60870-5-104]	Tele-control equipment and systems- Transmission protocols - Network access for IEC 60870-5-101 using standard transport profiles
[IEC 61850]	Series of Standards - Communication networks and systems in substations
[IEEE 802 series]	Local Area Network
[IEC 61131-3]	Programmable Controllers – Programming Language
[IS:6911-1992]	Specification for Stainless Steel and Strip
[IEC 60297]	Specification for 19-inch rack
[IEC 60529]	Degree of protection provided by enclosures (IP Code)
[IEC 62040]	Specification for UPS
[IEC 60146]	Specification for Semiconductor Converter
[IS 694]	PVC Insulated cables for working voltages up to and including 1100 Volts.
[IS 1554-Part I]	PVC Insulated Cable (Heavy Duty) Electric Cables
[IEC 60255-5]	Insulation coordination for measuring relays and protection equipment – Requirements and tests

[IEC 60255-21]	Vibration, shock, bump and seismic tests on measuring relays and protection equipment
[IEC 60255-22]	Measuring relays and protection equipment - Part 22-5: Electrical disturbance tests
[BS 6651]	Lightning Protection
IEC 61643	Components of low-voltage surge protection devices
IEC 61312	Protection against lightning electromagnetic impulse
IEC 61024	Protection of structure against lightning
[IS 3043-1987]	Code of Practice for Earthing
[EN 50122-1]	Railway applications - Fixed installations - Protective provisions relating to electrical safety and earthing
[BS 7671-2001]	Requirement for wiring Installation, IEE Electrical Wiring Regulations 17 th Edition.

10.3 DESIGN CRITERIA

General feature and basic design requirement for SCADA equipment at the OCC and at the field Equipment are as under:

10.3.1 Basic Design Requirements

The Contractor shall examine the scope of work and scrutinize the specified system, specification for cables and equipment and work out the ratings and capacities based upon his own designs, for approval of the Engineer. The design of the system, including all sub-systems and equipment shall be evolved based on principles as indicated in clause 4.4 along with the following additional principles:

- (a) Adequate redundancy in system such that any single point failure shall not degrade the system availability or performance of SCADA equipment in any way; the second level of failure shall be able to meet with crisscross redundancies.
- (b) Ergonomically designed to ensure no long term fatigue or cumulative injury to the operators;
- (c) Adherence to operational performance requirements;
- (d) The SCADA equipment shall meet the environmental conditions as below

Minimum Temperature	: 5°C
Ambient Temperature	:29°C
Maximum Temperature	:35°C
Relative Humidity	: Minimum 0%, Nominal 65%, Maximum 95% (Non Condensing)
Electrical Noise	: High Frequency to 1MHz, 1kV damped to 50% after 6 cycles. : Radio Frequency field strength 10 V/m, UHF & VHF bands.

- (e) SCADA equipment shall be self-monitoring i.e. failure of any piece of equipment down to the individual RTU Card level (I/O card, Power conditioning, Controller card etc. as applicable) shall cause an alarm locally and as well as at the OCC.
- (f) The SCADA architecture shall permit up-gradation of I/O numbers upto 20% to include more controlled switching stations / additional equipment.

- (g) SCADA equipment shall incorporate hardware and software for Multi-tier access control features as per the allowed level of Command that prevents access by unauthorized persons; the unsuccessful login shall be alarmed and logged at OCC. Unsuccessful Entry Access to the SCADA rooms at TSS, SSP and SP shall also be logged and alarmed at OCC.
- (h) Any equipment manufactured shall have its failure rate determined strictly in accordance with its appropriate operating environment.
- (i) In rare instances failure of a single item of equipment may be tolerated for a short period of time provided that only a small part of the overall system is affected and the occurrence does not take place more than once per year. However, redundancy shall be incorporated where failure cannot be tolerated even for short periods.

(j) Noise

All SCADA system equipment shall operate satisfactorily in the very high “electrical noise” environment normally associated with Freight systems due to electrical fields created by traction supplies and strong magnetic fields. Equipment shall be immune to the effects of conducted and radiated electrical interferences.

The SCADA equipment shall comply following CE norms:

Standard	Norms
EN55022	Electromagnetic Interference
EN55024 (IEC 61000-4-2,3,4,5,6,8,11)	Electromagnetic Immunity
EN 61000-3-2 (IEC 61000-3-2)	Power line harmonics
EN 61000-3-3 (IEC 61000-3-3)	Power line flickers
EN60950 (IEC 60950)	Product Safety

(k) Lightning Strikes / Power Supply Surges and Disturbances

- (i) The design shall ensure that all SCADA equipment are fully protected against the effects of power supply surges and direct and indirect lightning strikes and provided with lightning Protection Units.
- (ii) Lightning protection systems/ units shall be in accordance with BS 6651 –“Lightning Protection” or any equivalent Indian/ International Standard.
- (iii) All surge suppression equipment shall be self-contained and self-resetting. The suppression equipment shall be so selected that the let-through voltage specification does not exceed the absolute maximum voltage specified for the particular equipment being protected.
- (iv) Signal lines from external sensors / transducers etc. at risk from the effects of lightning shall have surge suppressers fitted at both ends and shall be installed and connected in accordance with the manufacturer’s recommendations.
- (l) The Scope shall include any equipment for the systems and the sub systems, necessary for the complete, safe, reliable, operable and maintainable SCADA equipment.
- (m) The design shall employ the quality procedures and best practices for selecting the equipment. It shall be possible to replace the faulty unit instead of whole equipment.

10.3.2 Modular Equipment and Components

- (1) To the extent possible all components shall be modular in construction to facilitate easy troubleshooting and replacement of components to minimize down time of the system. Where equipment is of the same type, rating, equipment shall be interchangeable.
- (2) Open systems shall be employed such that if items from one supply becomes economically unviable or non-available, products from other suppliers will be available and compatible. The contractor shall furnish the list of Equivalent cards of all types of cards installed.

10.4 DOCUMENTATION SUBMISSION REQUIREMENT

Documents to be delivered by the contractor shall include but not limited to the following:

(1) Design stage

The Contractor shall design the SCADA equipment as per the design requirements. These shall include but not limited to:

- (a) SRS on the SCADA equipment,
- (b) SCADA architecture,
- (c) RTU Drawings and HMI Design Documents,
- (d) Input/Output (I/O) list,
- (e) Control and Logics of each operation,
- (f) Proven-ness certificates / evidences of Proven & Satisfactory Performance
- (g) Proposal of SCADA equipment ratings and makes in the required format as prescribed by The Engineer;
- (h) Calculation of Conductor sizes and core numbers for all control cables for SCADA,
- (i) Identification of the bandwidth required,
- (j) Earthing requirements, calculations of safe touch and step potentials for the SCADA Equipment and EMC Control Plan for SCADA, ,
- (k) RAMS requirement with MTBF and MTTR and the V&V matrix for each module,
- (l) Type test reports for equipment or components selected for SCADA,
- (m) Design requirements taking into account Human Factors and Work Load Assessments at OCC.
- (n) Hardware and Software Obsolescence management plan,
- (o) Interface management plan, includes interfaces with other sub- system/ contractors/other sections of HORC,
- (p) Factory Test, Site test, Integrated test plan, Identification of System critical parameter,
- (q) Control and Logics of the fault localization in different failure scenarios or faults at different points in OHE system and shall submit as a separate diagnostic

module,

- (r) Fault diagnostic module for hardware/software faults,
- (s) Modules on various utility Program which may be required by the Operator/management to Capture Historical Data, Trend, Demand control and Alarm Management including power Block management.
- (t) The detailed procedure for switching from Main server to the other server at the OCC based on design of the SCADA system along with periodicity.

(2) Construction/ Installation Phase/stage

- (a) Construction and Installation Plan;
- (b) Quality Plans and RAMS Plans;
- (c) Installation, operation and maintenance instruction of all equipment;
- (d) Drawings of equipment;
- (e) Inter-connection Drawings;
- (f) As built Drawings including interface Drawings;
- (g) Earthing and Bonding plans;
- (h) Updated EMC Control Plan and certificates;
- (i) Site access control system; Operation & Maintenance Manual with Fault diagnostic;
- (j) List of installed Spares, spare space in the cubicles, Mandatory spares as delivered and recommended spares.

10.5 CONTROL AND MONITORING REQUIREMENT

10.5.1 The SCADA system shall monitor & control the equipment at following as a minimum:-

- (1) Traction Substations;
- (2) Sectioning Posts;
- (3) Sub-Sectioning Posts;
- (4) Stand alone Auto Transformer Stations if needed as per traction simulation study;
- (5) Protection system;
- (6) Measurements at required points;
- (7) Fault locators, Power Quality equipment(s) etc.;
- (8) Motorised Isolators and Interrupters in stations/ yards;
- (9) Monitoring of Auxiliary transformer(s) Power supply at TSS, SSP and SP including those provided for stations.

(According to indicative designs, the location of the principal sites to be controlled and monitored is shown in Part 2, Section VII-3: drawings).

10.5.2 The Contractor shall confirm the exact number and configuration of each type of

switching station (TSS/SSP/SP) as part of the works described in this Particular Specifications.

10.6 INDICATIVE LIST OF EQUIPMENT TO BE MONITORED AND CONTROLLED AT REMOTE LOCATIONS

10.6.1 Table 10.1.1 provides an indicative overview of the typical items of equipment that will be required to be monitored and controlled in each Installation on Prithla to New Harsana Kalan section of Package SYS-1 of HORC Project. The list is not exhaustive and may not cover all the equipment and functionalities. The Contractor may be required to provide functionalities, Monitoring & Control of additional Analog & Digital I/O points as required by the Engineer.

Table 10.1.1

INDICATIVE LIST OF EQUIPMENT TO BE MONITORED AND CONTROLLED AT REMOTE LOCATIONS

Equipment	TSS	SSP	SP	SS at Station (If any)	Stations
Traction Transformers and Power Transformers	√	0	0	0	0
Auto Transformers	√	√	√	0	0
DP Circuit Breakers for 2x25kv AT System	√	√	√	0	0
DP Interrupters for 2x25 KV AT system	√	√	√	√	√
Motorised DP Isolators for 2x25 KV AT system	√	√	√	√	√
Motorised SP Isolators for 2x25 KV AT system	0	0	0	0	√
LA on secondary end of Transformer	√	√	√	√	0
132 kV Circuit Breakers	√	0	0	0	0
132 kV Motorised Isolators	√	0	0	0	0
LA on Primary Side of Transformer	√	√	√	0	0
Power Quality Improvement Equipment	√	0	0	0	0
Battery Chargers	√	√	√	√	√
Auxiliary Transformers	√	√	√	√	√
Low Voltage Distribution Boards	√	√	√	√	0
Current and Potential Transformers	√	√	√	√	0
Doors and gate contacts	√	√	√	0	0

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Intruder alarms	√	√	√	0	0
Access control system	√	√	√	0	0
Fire alarm system	√	√	√	0	0
Automatic fault Locator	√	√	√	0	0
UPS	√	√	√	√	√
Video Surveillance System	√	0	0	0	0
11kV/440V power supply system (HTP, MDP, DG set) including tunnel substations.	0	0	0	0	√
Tower wagon shed Gate	0	0	0	0	√

- 10.6.2 The contractor (SYS-1) shall assess the requirement of Monitoring & Controls, Measurements as required and prepare an exhaustive list of I/O points, Tele-commands, Tele-signals and Measurands needed during full lifecycle with additional 20% requirement for future extensions and shall seek the approval of the Engineer during Initial stage of Design finalization. The decision of the Engineer on the level of monitoring, Controls and Measurements of Various parameters shall be final.
- 10.6.3 The SCADA system installed at all TSS shall be uniform with highest I/O points as required for TSS with required spare and installed Transformers / Equipment.
- 10.6.4 Above table includes Intruder Alarms and Access Control system status and alarms. The specifications for these items are covered in the Telecom Works for Intruder Alarm. The status of supply for Auxiliary Transformers provided at Power supply installations of TSS, SSP and SP Installation to be included in the Traction SCADA.
- 10.6.5 The SCADA system shall be integrated with the smart card based Access Control and maintenance locking off system provided in Traction Power Supply Installation premises.
- 10.6.6 The SCADA system shall be integrated with fire control system to notify SCADA Operator for any untoward fire situation at traction power supplies installation.
- 10.6.7 The video Surveillance system, under the scope of Package SYS-1 contractor for Prithla – New Harsana Kalan Section, shall provide effective real-time video surveillance of the Traction Substation from OCC. The equipment shall be provided by Contractor SYS-2 (S&T contractor) and necessary interface shall be done. The contractor shall arrange the video Surveillance for the following::
- a. Main Entrance gate,
 - b. Incoming Bay area,
 - c. outgoing bay area,
 - d. Transformer area and,
 - e. Power Supply Control room Building Area
- 10.6.8 In addition to the above, the Contractor SYS-1 shall provide of one additional Client PC workstation with 21 Inch full HD LED backlit colour monitor for viewing, monitoring and management of Video Surveillance Data at the Traction Power Controller (TPC at OCC control room) as required and specified by the Engineer.

10.7 PERFORMANCE REQUIREMENTS

Performance requirement for SCADA equipment in the OCC and at the fields' level are being specified hereunder..

- 10.7.1 The SCADA system shall be fully equipped with all cards and command levels for both the TSSs and associated bay equipment.
- 10.7.2 The SCADA systems shall continue to be able to function should there be a mass trip of all equipment at every TSS, SP, SSP and SS. The OCC shall continue to function normally in such an event. The Server, Work Station and RTU processor and memory usage should not exceed 60% during Mass trip.
- 10.7.3 Complete SCADA system with servers, workstations, and full communication with all RTU's shall be ready within 15 minutes of a cold restart of complete system. All software shall automatically start up on system restart and system shall be ready for the operator after entering the password/ other security Check like Finger touches/ face recognition.
- 10.7.4 The SCADA system shall be able to initiate a change of state at the output of an RTU within <1 second of initiation by the control room operator. If this change has not occurred in the field for any reason, the operator shall be notified that the command was unsuccessful. The Contractor shall demonstrate the past performance of similar system provided elsewhere by them with client's Certificate while proposing for implementation on HORC as per the Scope of work.
- 10.7.5 The SCADA system shall indicate the change of state or change in alarm status within <1 second of receiving the signal at the input to an RTU.
- 10.7.6 The Total time of any commanded operation including all propagation delays shall not be >2 second i.e. from Initiation to receipt of Confirmation at work station.
- 10.7.7 The SCADA system shall be capable of time stamping with a resolution in conformance to IEC 60870-5-104 and IEC 61850 as required.
- 10.7.8 The SCADA system at OCC shall support data acquisition from RTU or other IED over Ethernet based IEC 60870-5-104.
 - (a) Open protocol, with Ethernet can support time stamped Data streaming, clock sync;
 - (b) Shall support Ethernet IEE802.3, X.21 and Ethernet;
 - (c) Shall Support Data Link Layer- IP (RFC 1661), RFC 894), Ethernet II, IEEE802.3;
 - (d) Shall Support Network Layer- IP (RFC 791),;
 - (e) Shall Support Transport Layer- TCP (RFC 793)/ UDP;
 - (f) Shall Support Application Layer – IEC 60870-5-104;
 - (g) Shall Support -Point to Point, Multipoint, Star, Ring Topology.

10.8 RAMS REQUIREMENTS

The RAMS shall conform to EN 50126 / IEC 62278 -.The contractor shall design the SCADA system to meet the RAMS targets specified for the system.

10.8.1 Reliability Requirements

- (a) The SCADA system shall be of the highest reliability. The OCC equipment shall have 100% redundancy as a minimum.
- (b) In the event that if SCADA system fails then the traction power and its protection system shall continue to operate autonomously, until either the SCADA system comes on line or until the switching station is placed into local control.
- (c) All OCC equipment shall be supplied power from two independent sources of supply.
- (d) The design shall consider Multi-tier, Multiuser Security at server level, Operator Work station and backup storage of data in SCADA.
- (e) Single point failure should not impact the SCADA performance.

10.8.2 Availability Requirement

The SCADA system shall be designed to achieve at least the following levels of system availability:

- (a) The complete SCADA system shall be designed to meet 99.99% hardware availability.
- (b) The availability figures for Traction Power functionality and the Traction power decision support system shall be 99.97%.
- (c) In determining the availability of the Delivered System, Reliability Block Diagrams using expected failure rates for off the shelf equipment shall be produced.
- (d) The System shall be designed to ensure that failure of any major equipment, caused by external accident or negligence of the internal staff or malicious damage by external influences or fire will not lead to unavailability of the whole system, other than a temporary outage of the failed equipment. For this purpose the SCADA system shall provide through pre-determined algorithm the steps to be adopted by the Controller to retain the system in healthy condition to the extent feasible.
- (e) In event of communication failure at any control Post, the particular post shall record changes within the switching station until communications are restored and RTU shall update current status and change history shall be transferred to the master station for recording in the logs of Events.
- (f) The Contractor shall prepare a detailed maintenance strategy for the SCADA system, detailing how system availability will be maintained.

10.8.3 Maintainability Requirement

The SCADA shall employ a unit spare replaceable based maintenance methodology. The Fault diagnostic software shall be able to diagnose and report the SCADA module (I/O Card, Controller card, Communication Port, Power Supply Unit card) failure. The SCADA system shall have an MTTR of 30 minutes excluding the communication failure. This time shall not include the time taken for a maintenance staff to arrive at the initial reported failure site.

- (a) The Contractor shall demonstrate that system maintains and fault diagnostics ability is sufficient to support the claimed system reliability and availability performance. The Contractor shall demonstrate that maintenance errors have been considered and risk of maintenance-induced faults has been mitigated in design.

- (b) The equipment to be supplied by the Contractor shall be designed for minimum maintenance. Maintenance activity required shall be capable of being performed without affecting the train service.
- (c) Maintenance activities shall be classified into two areas, routine preventive and corrective, both of which affect service availability.
- (d) The SCADA equipment shall be selected from a common palette of materials to ensure that equipment/ cards are interchangeable between sites, spares and training on multiple systems is kept to a minimum.
- (e) To optimize speedy corrective attention or maintenance, techniques employing automatic diagnostics test points, and rapid repair facilities for the SCADA and traction system as a whole shall be provided. To this end, expert system algorithm to identify location of OHE faults based on auto — transformer neutral Current & voltage shall be provided to the controller.

10.8.4 Safety Requirements

- (a) The contractor shall demonstrate that no safety loop is infringed due to SCADA failure. The installation design shall incorporate measures to avoid presenting safety hazards to people.
- (b) The Systems design shall incorporate measures to provide for its safe management and operation. The system shall ensure that there is no inadvertent operation of any SCADA controlled equipment.
- (c) The Systems shall not give rise, or be subjected to dangerous interactions within the railway or with other systems through fail safe interlocks.
- (d) The design of the earthing system shall conform to EN 50122-1. The system shall have fail-safe features. The Contractor shall incorporate the SCADA earthing design requirements in the earthing and bonding management plan and design as described in this Particular Specification.

10.8.5 Safety Targets

- (a) The Contractor shall demonstrate that the systems have been designed to minimize the risk due to operator and maintainer error, considering both the ergonomic aspects of the System design to reduce the likelihood of error, and protective measures adopted to mitigate the consequence of such error.
- (b) The Contractor shall show that the systems can be operated and maintained safely. The Contractor shall prepare a quantified risk assessment (QRA) to model the risk to (a) public; (b) maintenance and operations staff; (c) public and staff, on the adjacent Indian Railways line. The QRA may be based on a comparison of System features and operating practices with other high current main line railways and heavy haul railway systems for which risk levels are known. Accidental charging of dead section due to problem with SCADA or wrong indication causing issue of permit to work on charged section posing safety hazard shall also be prevented.
- (c) Following types of interlocks shall be possible:
 - (i) Interlock between any numbers of items of equipment through OCC such as N-1 interlock.
 - (ii) Interlock locally within equipment reporting to single RTU. This shall be possible without intervention of OCC server.
 - (iii) Interlock between equipment reporting to different RTU's on same LAN/TCP/IP connectivity. This shall be possible without intervention of OCC

server.

10.8.6 Specific Safety Requirements

- (a) In addition to the safety rules which shall apply for the entire system, the operation and maintenance of equipment inside the TSS, SSP, SP and SS shall satisfy the safety rules and system operation requirements of state power companies.
- (b) The system shall comply with all the relevant safety documentation, including, but not limited to 'Project Safety Manual' and any update thereof.

10.9 FUNCTIONAL REQUIREMENTS

10.9.1 General

- (1) Functional requirement for SCADA equipment in the OCC and at the fields' level are being specified hereunder. The Contractor shall design, manufacture, install and commission the SCADA equipment to provide a safe, efficient and effective means of monitoring and /or controlling the connected equipment as required for the operations of the project.
- (2) The SCADA system shall comprise of three basic elements:
 - (a) Interface with SCADA workstations and SCADA maintenance terminals for displaying the status of connected equipment to operators and providing control facilities for operators for connected equipment;
 - (b) Data communication links with the connected equipment to be controlled and / or monitored within the Project including use of the Data Transmission System provided by the contractor and necessary interface with Contractor SYS-2 for OFC cable communication link shall be done by Contractor SYS-1.
 - (c) Processing the information that allows:
 - (i) The information received from the connected equipment to be displayed in a consistent format.
 - (ii) The controls entered by operators to be converted into a form that shall be understood and correctly acted upon by the connected equipment.
 - (iii) The storage of all controls, events, alarms and measurands of current & voltage readings including transients to facilitate analysis of data and system behavior, including trend.
- (3) The SCADA system shall have levels of redundancy in its equipment and configuration as necessary to meet the System Performance requirements.
- (4) As a minimum, the central servers shall have dual redundancy with one set of servers located at the OCC equipment room interconnected with multiple redundant and spatially diverse data communication links.
- (5) Multiple, redundant configurations shall be used where necessary to ensure adequate operational safety and availability for all the SCADA equipment, SCADA System interconnections and SCADA interfaces to equipment to be controlled and /or monitored.

- (6) Redundancy shall be achieved either with hot standby equipment where only one unit is in use at a location or by utilizing several functionally identical units with an overall capacity such that one of the units may be taken out of use without loss of any functionality.
- (7) The SCADA System shall have a distributed architecture with the majority of I/O being transmitted via high speed data communication links.
- (8) The SCADA system architecture shall be arranged to minimize the requirement for marshaling large quantities and long lengths of metallic control cable to data collection points.
- (9) Primary control and monitoring of connected systems shall be from the SCADA workstations in the central control room combined with playback functionality.
- (10) Additionally, the SCADA system shall include a data link to a maintenance management system (MMS). This link shall enable the SCADA System to forward fault information to the MMS from all connected equipment to identify the location and nature of faults.
- (11) The mechanism of control and monitoring shall ensure that the connected equipment shall continue to function correctly and in a safe manner in the event of malfunction of parts or all of the SCADA System.
- (12) Control capacity, status and alarm messages displayed at each SCADA Workstation shall be limited / filtered according to the login privileges of the user.
- (13) The SCADA System shall be configured to permit phased commissioning of the project.
- (14) SCADA Software shall be able to carry out concurrent Maximum Demand (MD) calculation and initiate alarm based on the trend of MD before completion of Integration period at OCC as per pre-set values, which can be altered / set by Administrator as per the requirement. The User friendly provision shall be made in the software for the same.
- (15) The SCADA system shall be designed such that no single point failure of SCADA component results in failure of OCC functionalities or of the SCADA System.
- (16) The SCADA system shall through 100% redundant Controller display information on the video wall to be provided by the Contractor.
- (17) The Contractor shall examine the whole scope of work and scrutinize the specified system, specification for cables and equipment and work out the ratings and

capacities based upon his own designs, for approval of the Engineer.

- (18) The list of "I-O" requirements giving details of event type, alarm class and event text for TSS, SP, SSP, SS and AT stations shall be submitted and approval obtained from the Engineer. Notwithstanding the Approval of the Engineer, the Contractors shall ensure the complete functionality and minimum of 20% spare Installed I/O Cards of each type. Each installed card shall have minimum of 20 % spare I/O points. In addition the Contractor shall handover the spares as specified in relevant chapter.
- (19) The SCADA system Hardware & software design shall permit making suitable changes/ modifications for / in features or adding new I/O requirements like, alarms in case of maximum demand is exceeded, generating exception reports etc.

10.9.2 Supervision Architecture

- (1) The SCADA system comprises of RTU's at TSS, Switching Posts (SP, SSPs & SS) and Energy Meters at Aux. Transformer Locations for necessary field data collection and data transfer to Control Center.
- (2) Optic Fiber Cable Ring shall serve as the back bone of whole data transmission network and the Servers at OCC will acquire all the information's pertaining to the RTU's over IEC 60870-5-104 protocol.
- (3) TSS shall include Protection, Control, Monitoring and transmission to the Local Interface Unit (LIU) and Control Center. LIU can control the TSS after OCC permission.
- (4) The RTUs at TSS, Switching Stations (SSP/SP) and SS at Station shall collect data from fault locators and transmit to Control center.

(5) Control Center

(a) Operation Control Center (OCC)

The OCC SCADA equipment shall be organized in OCC Theatre and various rooms designated for SCADA purpose.

(b) Local Interface Unit (LIU) in TSS

The Traction Sub-Station (TSS) shall be provided with RTU capable of communicating with Bay Controller Units (BCU) or Intelligent Electronic Device (IED) over IEC 61850 protocols and shall be further integrated with SCADA system in OCC over IEC 60870-5-104 protocol via redundant Gateway. The gateway shall have redundant communication ports for simultaneously reporting to two masters.

The workstation in TSS shall serve as Local User Interface (LUI) for use of local operator.

- (6) Conceptual SCADA system configuration for Prithla – New Harsana Kalan section is as follows attached in drawing in Part 2, Section VII-3.

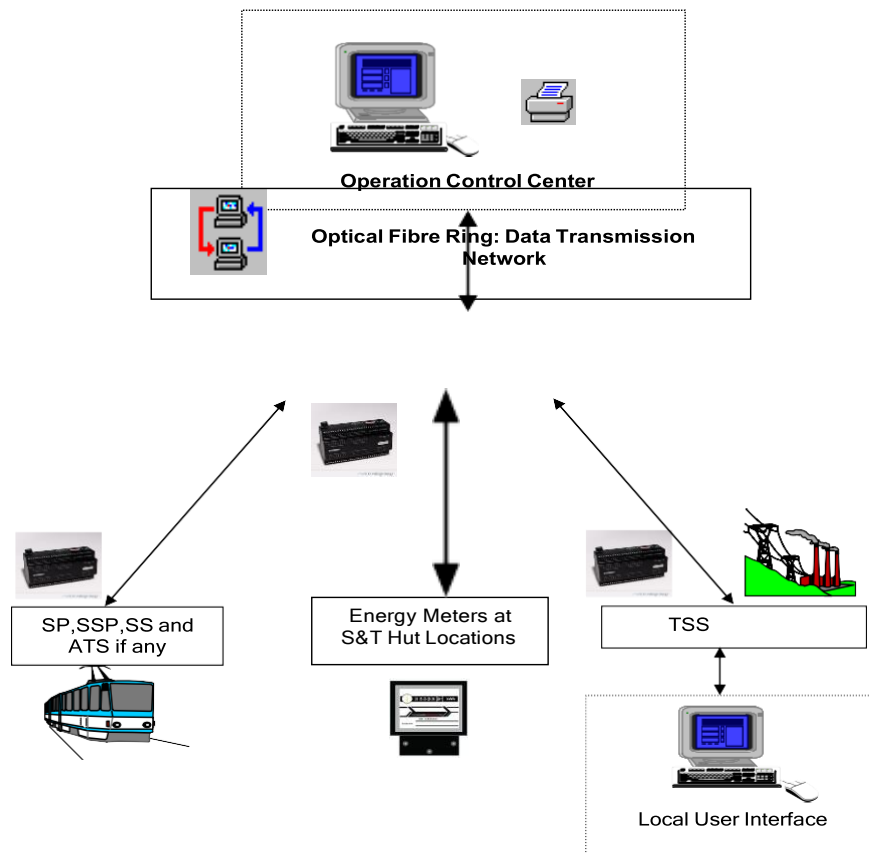


Figure 10.5.0-1 Typical Arrangement of SCADA System for SYS-1 of HORC

- (1) The SCADA system shall comprise, without limitation to the following:
 - a) Operation Control Center (OCC);
 - b) Field equipment for Control and Monitoring at Power Supply Installation;
 - c) Data Communication Network

10.9.3 Control Strategy And Authorization Management

- (1) In addition to above said control possibility, control of power supply equipment shall also be possible from local control panel of equipment, which shall ensure that the traction power supply installation and its protection system shall continue to operate in the event of failure of SCADA system. The following levels of controls should be possible from SCADA system of HORC.
 - (a) Centralized Control
 - (b) Local control mode from TSS for local equipment only: Operation Control Center has to grant "Permission for Local Operation" and all such authorization by Traction Power Controller shall be recorded in event list by SCADA system.
 - (c) Local mode from the equipment: It shall be possible to operate the equipment

locally from the control panels by selecting the local / remote selector switch in the Control Panel/equipment. This selection shall be logged in the event list by SCADA system.

- (d) Such control shall be only possible after taking "Permission for Local Operation" from the Traction Power Operator. This shall be also logged in event list by SCADA system.
- (2) A control transfer mechanism shall be developed based on above principle and confirming to operation requirement of HORC and implemented in SCADA system at various control points (Central, Local, Equipment etc.)

10.10 Remote Terminal Unit

(1) General

General requirement for fields' level equipment viz RTU, under provision of SYS-1 Contractor's scope of work shall as minimum, compliance with the following;

- (a) Remote Terminal Unit (RTU) shall be installed at all TSS, SP, SSP, and SS. It serves as interface between switching stations (All TSS, SP, SSP and SS) and master station (OCC); RTU for SP and SSP shall be interchangeable.
- (b) RTU shall be able to perform both data acquisition and local data processing. In the case of a communication path failure, the RTU shall operate as an independent intelligent unit and acquire and store data without interruption. On resumption of normal communication, the data shall be transmitted to the SCADA system;
- (c) The RTU shall support remote programming facility using RTU programming utility software from the master control Centre. A port on the RTU shall be dedicated to the master control Centre via one separate non redundant Ethernet communication channel;
- (d) The RTU shall be capable of communicating over IEC60870-5-104 with Control Center, IEC 61850 for interface with Relays, BCU, IEDs; IEC 60870-5-103 for interface with protection equipment; Modbus protocol for communication with Energy and Multifunction meters on Ethernet communication with Intruder Detection system and Access Control System.
- (e) In case of failure of communication between control posts and OCC/BCC, the local protective relays shall continue to function with all their protective features, including the lock out features on a persistent fault. All information in regard to the occurrence including data shall be stored in the RTU end for up to at least 1000 events and shall be transmitted the OCC on resumption of normalcy.
- (f) RTU shall continue to operate all safety features during failure of SCADA channel to OCC.
- (g) The RTU shall be capable to handle analogue input, digital input, and control output signals.
- (h) For each traction power supply Control post, the RTU shall be equipped to handle all the I/O points as required. In addition, the RTU shall include fully configured spare I/O points (Minimum 20% in each type of card) available for

the Employer's use; The RTU for a TSS without any standby traction transformer should allow addition of standby traction transformer and associated equipment.

- (i) The RTU shall have an internal clock for data collecting coordination and time tagging. The internal clock shall be completely independent of the synchronization source so that the RTU shall continue to properly handle its time related application in case of source and communication failure.
- (j) RTU shall support maximum demand (apparent power) calculation based on 5 to 30 minutes window periods based on inputs received from energy/power transducers similar to that of Power Utilities matched with time clock. The value of Maximum Demand (MD) shall be reported to OCC after each window period;
- (k) It shall be possible to reset the CPU of RTU from OCC in case it hangs due to any reason;
- (l) High-resolution sequence-of-events (SOE) processing and reporting capability shall be as follows;
 - (i) Detect changes in the state of SOE points;
 - (ii) Record the date and time of change with a resolution of ± 1 ms;
 - (iii) Ability to retransmit stored SOE data if requested by the system Master Station in order to ensure that SOE data are neither lost nor overwritten until the RTU acknowledges the receipt of the data. A buffer capable of storing at least 1024 events shall be provided;
- (m) Ability to communicate with the local user interface (LUI) for control & Monitoring / maintenance purposes in case of communication link failure with OCC;
- (n) It shall be possible to increase the number of communication ports in the RTU by addition of suitable cards, if required in future;
- (o) It shall be possible to mount the IO modules and the processor/communication modules in the same rack of RTU.
- (p) RTU software shall be capable of being reconfigured (under password control) locally from the laptop/portable programming device and from the central master station by using IP based RTU maintenance software. Contractor shall furnish authentic copies of RTU software in Hard Disc Drive (HDD);
- (q) The RTU shall have self-monitoring/diagnostic for fault conditions. This shall provide various details such as status of ROM, data bus, RAM check, battery low, defective cards etc. The RTU should generally support the test procedures as per standard protocol IEC 60870-5-101 & 104;
- (r) The RTU address shall be configurable. The RTU address shall not be lost in case of power swings or surges. It shall be possible for the Employers' Staff to reconfigure the address for the remote station.
- (s) In case additional RTUs are to be configured, configuration manual shall be provided by the Contractor and the Employer's Staff should be trained to configure additional RTUs as and when required.

(2) RTU Cabinets

- (a) The RTU installations shall be dust, rodent and vermin proof with doors. The doors shall have proper rubber gaskets & locking arrangement. The cabinets shall have facility for bottom/top entry of incoming/outgoing cables for operation of the equipment. The Cabinet shall be manufactured from CRCA sheet of Minimum Thickness of 1.6mm (with Door of minimum thickness of 2.0mm), Passivized, cured and acceptable quality treatment, powder coated (with 7 tank processes) so as to make the surfaces rust and scratchproof quality. Suitable reinforcements shall be provided wherever necessary.
- (b) The RTU shall be floor mounted. The Contractor shall offer as small cabinet as possible without compromising on maintainability and serviceability of the RTU equipment. There shall preferably be only one RTU cabinet housing all equipment. All RTU enclosures located indoor shall conform to minimum Ingress protection class IP 54 as per IEC 60529. All enclosures located outdoor/ open/under shade shall conform to minimum Ingress protection class IP 65 as per IEC 60529. The interior of the panel shall be lit on opening, using a CFL/LED lamp by a door controlled switch.
- (c) Modular type of construction shall be adopted to facilitate unit replacement of devices wherever required. Surface mounted technology or better (SMT) shall be used for higher level of reliability. Standard plug-in and connector arrangement shall be made for the printed cards.

(3) RTU Wiring

- (a) All internal RTU control circuits and wiring of DI/DO & other signal circuits between Control and Relay (C & R) panel and RTU shall be with at least 0.75 sq mm, 1100 VAC / 1500V DC grade PVC insulated copper conductors conforming to IS 694.
- (b) RTU shall be wired with 1.5 sq mm XLPE insulated copper conductors conforming to IS 7098, 1100V ac/ 1500Vdc grade (screened wherever necessary) only for main incoming 110Vdc & 240 V ac power supply (4 sq mm copper only for CT wiring).
- (c) Harnesses of wires/cables shall be neatly dressed, laid in metallic and supported suitably. Separate wire bunches shall be run for ac, dc, control and data circuits. Caution plates and name labels shall be provided inkeeping with good engineering practice.

(4) RTU Software

- (a) The term "RTU software" used in this Particular Specification means software used at RTU generally implemented through firmware. All Software shall be implemented according to the Contractor's established design and coding standards. Complete and comprehensive documentation shall be provided for all software to the extent that it is used in any way to configure or manage the system.
- (b) The RTU software shall provide automatic restart of the RTU upon power restoration, memory parity errors, hardware failures, and manual request. It shall initialize the RTU and begin execution of the RTU functions without intervention by the OCC. All restarts shall be reported to the system Master Station.

- (c) In order to provide for easy upgrading and/or correction, the RTU software shall be stored on a removable flash memory card. In addition, it is required for the RTU to perform the following tasks remotely:
- (d) RTU software and database maintenance;
- (e) RTU diagnostics;
- (f) Configuration of RTU parameters and programmable logic functions;
- (g) The RTU software shall also support an easy, user-friendly human interface enabling an authorized operator to perform local supervision, control and/or maintenance of the RTU. There shall be a context sensitive interactive help window, e.g., a pop up text window displaying relevant help information.
- (h) The System Functions to be supported by the RTU Software shall be as follows:
 - (a) Equipment control;
 - (ii) Equipment indications;
 - (iii) Equipment alarm and event handling facilities;
 - (iv) System configuration and database maintenance;
 - (v) Manual and automatic control function configuration;
 - (vi) Protocol management;
 - (vii) Measurement values and computations;
 - (viii) Automatic self-diagnostic;
 - (ix) Help information;
 - (x) Archiving.

(5) Local User Interface (LUI), Only for TSS RTU's

- (a) The RTU shall support a LUI for use by the Employer's staff and shall allow local operation.
- (b) As a minimum, the LUI shall perform the following functions:
 - (i) View remote station data and alarm information on graphical and tabular displays. This function shall include one-line diagram displays of the associated substation for viewing dynamically updating data and alarms.
 - (ii) Initiate control actions, such as opening and closing circuit breakers, interrupters etc. This function shall operate on a Select-Check-back-Before-Operate (SCBO) basis, and shall include appropriate security to prevent inadvertent and unauthorized control actions.
 - (iii) Store historical information such as alarms, events and analog measurement. Maintain LUI and RTU software, database, and displays.
 - (iv) Execute LUI and RTU diagnostic programs. The diagnostic programs are installed in the RTU-Software, thus no special installation shall be

necessary on the computers/laptops used to present the LUI.

- (v) Configure RTU system parameters.
- (vi) Configure RTU programmable logic functions.

(6) RTU Environment Conditions:

- (a) RTUs shall be subjected to severe temperature variations and vibration conditions produced by moving rolling stock. The amplitude of these vibrations is expected to be in the range of 30 to 150 microns, with rapidly varying time periods in the range of 15 to 70 ms and occasional peaks of 350 microns.
- (b) The track side cubicles shall not be air-conditioned and are liable for exposure to polluted, dusty and corrosive atmosphere. The environmental conditions are given in clause 4.2 of this PS. The RTU hardware shall be immune to electromagnetic interference from nearby high current electrical equipment, to ensure safe and reliable operation under all loads and faults. Electromagnetic compatibility (EMC) shall meet the requirements of relevant international standards.

(7) Protection against Surges

- (a) The power supply unit/DC-DC converter of RTU shall have internal protections against under voltage, over voltage, overload and short circuits in addition to adequate protection against surges and lightning in compliance of IEC-61643-12, 61312 & 61024 and DIN VDE-0100-534, as applicable.
- (b) In signaling line surge protection device of class D type shall be provided as per IEC 61643-21 & DIN VDE 0675 Pt. 6.

(8) Earths / Earth stations

- (a) Contractor shall provide a separate maintenance free low resistance (<1 ohm) Clean earth station for RTUs and SCADA Equipment. The RTU body/frame shall be suitably connected to the separate earth.
- (b) Overall responsibility to ensure suitable design of RTU earthing arrangement to avoid failures of electronic cards etc. in RTU shall be that of the Contractor.

(9) Electrical Protection for Power Supply

The Contractor shall ensure proper electrical protection by providing MCBs. There shall be one MCB per supply circuit.

(10) Redundancy

- (a) The Power supply cards for the RTU system shall work in (1+1) hot standby mode. Failure of one supply card and its switchover to the standby card shall not cause any interruption to the functioning of SCADA. All failures shall be recorded as an event and stamped with date and time.
- (b) The RTU shall communicate with the Master SCADA server through redundant communication channels. The RTU communication cards and the

server shall be, accordingly, configured. Redundant data channel of adequate bandwidth shall be provided by the contractor.

- (c) Processing Cards for the RTU shall be provided in (1+1) hot standby mode. Switchover from main to standby, card shall be transparent to the system functioning i.e. there will be no loss of function during the changeover period.

(11) PLC Programming Facility:

To enable programming for logic functions as required for the traction powersupply distribution application, the RTUs shall support PLC in compliance with IEC 61131-3. The required programming tool shall be within the scope of the work.

(12) Time Synchronization in RTU

The RTUs shall be time synchronized with the master Clock. Further the RTU shall support the following methods of synchronization:

- (a) Time synchronization of the RTU by the network control Centre (NCC) via a periodically transmitted synchronization instruction with a communication protocol supporting this function.
- (b) Time synchronization of the RTU using SNTP on a LAN network

(13) Cyber security Features

RTU shall be capable of User activity logging and role based account management with password complexities based on at least one character options.

(14) Central Processing and communication unit:

The Central processing unit shall employ at least a 32 bit microprocessor and a dedicated peripheral bus controller for handling IO functions and adequate RAM - flash memory and high processing power. Features shall be identical in the redundant CPU. The CPU module shall have nonvolatile memory. The CPU module shall support the following Ethernet and serial port requirements in one or more CPU modules;

- (a) It shall have necessary communication ports for communication with at least 2 control centers i.e. one main control Centre and one back up control Centre on IEC 870-5-104 protocol. Also the RTU shall be capable of communication with maximum of 8 masters.
- (b) It shall support data acquisition from energy meters.
- (c) The Central RTU shall include minimum of 4 serial ports using RS232/RS485 interface and 2 Ethernet ports to communicate with IEDs by using the IEC61850/IEC60870-5-103/DNP 3.0 protocol. The Ethernet ports in the communication modules shall be of 100 Mbps.
- (d) The RTU shall have one MMI port which may also be used for configuration purpose.

(15) Analog Input

- (a) The analogue inputs module shall have minimum 8 channels per module

and shall support dual slope integration A/D conversion.

- (b) The RTU analogue-to-digital (A/D) converters shall have a digital resolution of at least 11 bits plus sign.
- (c) The analogue module shall support the following signal :
 - (i) Unipolar Measured Values
 - (ii) Bipolar Measured values
- (d) It shall be configured for the following measurement ranges:
 - (i) 0 - 2.5 mA
 - (ii) 0 - 5.0 mA
 - (iii) 0 - 10 mA
 - (iv) 0 - 20 mA
 - (v) 4 - 20 mA
 - (vi) 0 - 1.0V DC
 - (vii) 0 - 10 V DC

The accuracy shall be better than $\pm 0.1\%$ on full scale.

- (e) Following Programmable parameters shall be supported:
 - (i) Live zero conversion coefficient Cyclic;
 - (ii) Transmission or threshold value Forced;
 - (iii) zero point conversion coefficient Limit;
 - (iv) Values Smoothing factor Threshold;
 - (v) Values Cyclic duration;
 - (vi) Priority of transmission.
- (f) Other parameters:
 - (i) Inputs shall be configurable for 4 to 20 mA / bipolar or live zero
 - (ii) Accuracy- $\leq 0.25\%$
 - (iii) Common Mode Voltage : ± 8 V DC
 - (iv) Line Interference suppression : > 100 d for $f = 50$ Hz

(16) Transducers:

- (a) The independent transducers converter/ multi-function transducers (MFT) required for acquiring Analogue inputs from CT/PT shall be supplied by the Contractor.
- (b) The transducers shall be selected for nominal 110 V ac (Ph-Ground voltage) and 1A/5A CT/PT inputs. The transducers shall withstand input voltages up to 120% of the nominal voltage and shall be suitable for 20% continuous over

load and 20 times the normal current rating for a period of one second.

- (c) Transducers shall provide at least the following parameters as a minimum with the specified accuracies.

Sl. No.	Parameters	Accuracy
(i)	Voltage (Each phase to neutral and phase to phase)	±0.5%
(ii)	Current (each phase)	±0.5%
(iii)	Active Power, Reactive power, Apparent Power	±0.5% / ±1%
(iv)	Import & Export Energy (active/reactive)	±1% / ±2%
(v)	Power Factor (measuring range)	0.5 lag to 0.5 lead
(vi)	Auxiliary Power supply	8.23.2 V dc

- (d) Temperature and pressure monitoring transducers shall be similarly rated and provided with the independent power supply drawn from local LT supply.

(17) Digital Input Module:

- (a) The Digital input module shall have at least 16 optically isolated channels per module and shall support time stamping with time resolution of 1 Ms. The digital input module shall support configuration of inputs for the following options:
- (i) Single Indications
 - (ii) Double Indications
 - (iii) Digital Measurands
- (b) The digital input module shall also support the programmable parameters including but not limited to:
- (i) Bounce Filter (Suppression Time);
 - (ii) Settling time for reliable digital measured value;
 - (iii) Chatter suppression;
 - (iv) Suppression of intermediate position;
 - (v) With / without time tagging shall be a configurable feature;
 - (vi) Configurability of message transmission priority.
 - (vii) Indication processing
- (c) Group or Common alarms shall be configurable from Individual alarms by Boolean operations;
- (d) Acquisition of events in chronological order with a time resolution of 1 ms - Buffering up to 3 changes per input.

(18) Digital Output

- (a) The Digital Output module shall support at least 16 digital output channels per module. The output module shall support time stamping with time resolution of 1ms and shall support following Programmable Parameters which shall include:
 - (i) Duration of output pulse
 - (ii) Release disconnection delay time at response indications
 - (iii) Select before execute
 - (iv) Cyclic duration
 - (v) Priority of transmission
- (b) Interposing contactors/relays for operating the closing and tripping circuits shall form part of the SCADA equipment. The contactors/relays shall be suitable for 110 V dc supply varying from + 10 % to -20 %. The contacts of relays shall have a continuous current carrying capacity of 5 A, making capacity of minimum 10 A and breaking capacity of 2 A inductive load. Suitable spark quenching circuit shall be provided to take care of breaking inductive loads.

10.11 SCADA SOFTWARE

10.11.1 The basic requirement of SCADA software for the HORC Section, as minimum shall be as under:

10.11.2 General Requirement

- (1) The software shall be compatible for working on IEC 60870-5-104 companion standard protocol based on IEC 60870-5-1 to 5 series of standards. It shall also support multiple channels for communication to all RTUs as per TCP/IP based IEC60870-5-104 communication protocol;
- (2) The software shall fully support data transfers between RTU & OCC as defined by different IEC 60870-5-104 series of standards;
- (3) The software shall give fast response to operator actions and system events. SCADA system stability should be sustained during event bursts. The software should be capable to support system working at high speed data transfer rates achievable over OFC communication networks;
- (4) Software/system performance shall not degrade or drift due to generation of temporary files etc. which the software shall clean/delete automatically;
- (5) Only the valid licensed copies (CD/DVD or in HDD as decided by Engineers) of complete SCADA application, commercial and peripheral software shall be supplied. The firewall /antivirus software provides shall be valid up to the Defect Notification Period (including extended DNP, if any);
- (6) SCADA vendor shall provide all necessary run time utilities for successful running of the SCADA application. The utilities supplied by the Contractor along with operating system should be sufficient to independently execute the SCADA software without any problem.

10.11.3 Functional Details Of Master Station Software

(1) Acquisition of measurands

- (a) The SCADA system shall be capable of acquiring measurands i.e. analogue inputs from the TSS, SSP, SP and SS including transient values. The measurand data shall be real time stamped/tagged at field level RTU.
- (b) Software shall have capability for Analogue value scaling, processing and conversion to engineering values, limit settings of parameters centrally from OCC or from any Point/ RTU.
- (c) Software shall be fully configurable to analyze the analogue data received from RTU e.g. energy parameters (active, reactive and apparent power & energy), voltage, current and power factor in the form of displays (graphs as well as tabular), trends, alarms to operator in case of set limit violations and historical interpretations.
- (d) Software shall also be able to analyze the transient analogue data for detection of faults and their corrective measures.
- (e) There shall be facility to transfer the data to spreadsheet applications like MS-Excel in .xml formats with User friendly Utility Program.

(2) Acquisition of Tele-signals

- (a) The software shall support the acquisition of tele-signal (bi-state devices) for each RTU.
- (b) There shall be dependent and independent points in the traction power supply system. For example, if a feeder Circuit Breaker Trips, there shall be associated tele-signals for catenary and 240 V AC fail. All such events shall be reported by RTU to OCC with time stamp.

(3) Execution of Tele-commands

- (a) The Software shall be capable of issuing tele-commands to open or close a switching device. All the commands shall follow select — check — execute and report back execution procedure.
- (b) The Tele-commands shall receive the highest priority in conformance to IEC 60870-5-104.
- (c) Operator shall be able to cut off power to a sub-sector by selecting it and giving the command. The system shall open all the associated switching devices automatically in appropriate order with confirmation for each device as an event.
- (d) Option to abort a command shall be available with the operator till it has not been acknowledged for execution at the switching stations. Any command which does not get executed within the specified time as per design, shall be automatically cancelled and confirmation to this effect communicated to operator.
- (e) All the operator commands shall be logged as events. After a control command is issued by the operator, and if the command is not executed, then a message shall be displayed indicating reason(s) for it.
- (f) The Tele-command once selected, if not sent to RTU due to communication failure or otherwise, shall be aborted after a predefined period of one (1) Second and shall not remain in queue and reported to operator.

(4) Parameter loading to RTU

- (a) The OCC software shall be capable of parameter loading to the RTU in line with IEC 60870-5-104 & other basic standards of IEC 60870-5-104 series. Some configurable parameters are as under:
 - (i) Dead band for RBE (Report by Exception) of an Analogue value.
 - (ii) Pulse duration of control commands.
 - (iii) Used point of each type in an RTU. (Number of point used of a particular type of point)
 - (iv) Event reporting details which include windows time and de-bouncing time.
- (b) The de-bouncing time, dead band for measurands and the clock synchronization time period shall be settable and so selected that the optimum use of data communication channel is made.

(5) SCADA software configuration

The software shall provide menu driven and user-friendly configuration. The configuration shall define the various devices, their attributes and the traction system specific details. The configuration of the software shall be carried out to cover all details/address/nodes of traction supply operation e.g. Interlocking, locked out signals, protection relays & elements, alarms with attributes, power blocks, parameter settings and display/picture screen properties etc.

(6) Time Synchronization

The master clock installed in OCC shall be used to synchronize the Host Computer clock and the clocks of the RTUs.

(7) Test Procedure & Diagnostics

- (a) The software shall support basic test procedure and diagnostic checks for RTU as per IEC 60870-5-104 & basic standards of IEC 60870-5 series. As in IEC 60870-5-104, there is no periodic polling for Class1/Class2 event from the master and all events shall be reported by exception from the RTU. The only periodic poll from the master shall be the general interrogation, at intervals not exceeding 10 minutes. Apart from this, master shall send a TESTER packet 10-15 seconds, to check the health of the RTU and communication media.
- (b) SCADA application software shall have minimum following inherent features to check its own sub functions and report status to the operator:
 - (i) Online/standby /offline state of SCADA server/communication front ends.
 - (ii) State of all RTUs.
 - (iii) State of printers.
 - (iv) Connection status of all the operator workstation.
 - (v) Diagnostics shall use standard OS tools to be provided as part of the administrator tools.

(8) Communication Failures

Time out of the RTU and the cyclic redundancy check (CRC) errors shall be progressively counted and displayed in a tabular report as "Communication failures" for each RTU. The tabular report shall be generated at 4.00 hrs., Every day for the preceding calendar day of 24 hours.

(9) System security and access levels

(a) The system shall provide three security levels for access for different functions:

- (i) Traction Power Controller (TPC): - To view and Control;
- (ii) OCC Engineer – To edit configuration information;
- (iii) System (Admin)/ Engineer- Able to do everything.

(b) The Contractor shall liaise with the Engineer as to which facilities each security level is given. This shall be undertaken in coordination with the Engineer developing the Control Room rule book.

(c) There shall be no remote/email/internet access, user access codes/passwords in the master station software and hardware so that any possibility of a cyber-intrusion or attacks is eliminated. Reasonable precaution, by way of installing fire-wall, and blocking ports for connecting external devices like pen drives, CD drives etc. shall be ensured. This will also be applicable for preventing the access, to manufacturer after the SCADA is handed over to Employer or access to any employee who has left the job.

(d) There shall be means to indicate & give alarm in case an intrusion event occurs either through a connection or a peripheral device.

(e) In addition backup and recovery procedures for the SCADA system shall be well defined by the Contractor. The Contractor shall train the Employer's staff on the security threats and vulnerabilities involved with IP based systems.

(f) The Contractor shall provide in OCC, a workstation with a general purpose computer for non SCADA applications. e.g. internet browsing and word processing. The general purpose computer will be connected to the general office LAN and NOT to the SCADA LANs. The computer shall be of latest version with at least 2 TB HDD and 256 GB RAM along with UPS.

(g) **System Users and User Authentication :**

User Access to all functions of system shall follow a consistent set of common user access guidelines. The user access to system, database, and operating systems shall be based on password authentication. Defining and controlling user access to the system shall be provided through independent domain server. The domain server shall be in redundant configurations. A user management application shall be deployed to manage and to help achieve seamless access to all applications after identity authentication of the users.

(10) Status Information

The SCADA system shall be able to display status information for switching station equipment such as device name and its current value/status, scans status (on/off

scan), override status and block status shall be displayed.

(11) Breaker Operation Counter

The system shall monitor operation counter of the circuit breakers. The operation counter shall segregate normal operations and fault tripping after analyzing the associated trip relay data. It shall generate alarms after a predefined limit of normal & fault operations is reached. If a pre-determined limit is reached then a maintenance flag shall be sent to the maintenance planning system. The operations counter data shall also be sent to the asset management system at a predetermined time each day.

(12) Block/Un-block control for devices

Facility shall be provided to block / de-block a control point (circuit breaker, interrupter and other controllable equipment or a set of controlled equipment at the controlled station). The block or unblock command shall disable/enable control operations from the OCC. The blocked condition of any equipment or a set of equipment shall be suitably indicated on the monitor.

(13) Boundary post operation:

The design shall be such that it shall be possible to provide interlocks between two control centers in future, if required to interlock any equipment or a part of section at the end of its zone of control. For example, when a post separates the zones controlled by two adjacent OCCs, control of breakers/interrupters at this post shall be so arranged that the breakers/interrupters can be closed by one OCC only when an interlock is released from the other OCC. However, opening shall be possible from any of the OCC, in such cases there shall be visual alarm indicating that the opening was initiated by another OCC.

(14) Alarm Processing and displays:

- (a) Blinking Visual and audio alarms shall get generated whenever the state of device is found to be in the abnormal condition or any measurand's set limit is violated, with facility with the operator to silence the audio part of the alarm and the blinking visual alarm is changed to steady state once for every alarm generation.
- (b) In the event of failure of RTU or any equipment at RCC such as Host or HMI, an equipment alarm shall appear. When both the auxiliary contacts of a device are either in open or in closed condition, such faults shall be detected and identified as "Complementary Faults". Such conditions shall be logged in alarm and event list. The alarm list shall be of two kinds — current and historic.
 - (i) **Current alarm list** shall contain minimum 400 entries. The list shall be ordered chronologically. Acknowledgement status of an alarm shall be indicated in the current alarm list.
 - (ii) **Historical alarms list** shall consist of all alarms for the last one month.
- (c) Operator shall be able to request for display of the alarms in chronological order starting from any given time. Provision for sorting of historic alarms on various options such as a geographical area, station-wise, Equipment wise or tag wise, and in chronological order shall be supported. Alarm list shall be printable on user's request or downloadable in a format compatible by commercially available spreadsheet software, clearly separating original & consequent alarm such as circuit breaker trip & consequent loss of voltage.

(15) Alarm acknowledgement

- (a) Page wise facility for alarm acknowledgement with a single click and confirm shall be provided in addition to one by one acknowledgement.
- (b) There shall be facility to define certain alarms with audible sound or pre-recorded voice to attract the attention of the operator as per user requirement.
- (c) There shall be facility for time delayed alarm operation e.g. alarm for tripped capacitor bank circuit breaker closing reminder.
- (d) There shall be a facility to label a post under maintenance & to disable the audio alarm for particular post/ RTU equipment by the operator. For scenarios such as contact chattering, it shall be alarmed as a failure and; visual indication of the discrepancy shall however remain active till its resolution. The list of disabled alarms shall be reported on the daily log each day until the alarm is reinstated.

(16) Events display

- (a) Events shall be logged separately for all commanded and for unusual un-commanded changes in equipment status, acknowledgement of alarms, limit violations of analogue points, successful and unsuccessful user login and markings done by operator from HMI shall be logged clearly with different heads.
- (b) The event list shall be of two kinds – current and historic, same as explained above and same facilities for sorting, displaying and printing of event reports shall be available.
- (c) Processed alarms: It shall be possible to create processed alarms in the system. For example, there are two events, event A and event B, which are not classified as alarms, however, if they occur both together an alarm shall be generated. It shall be possible to apply any Boolean operation or time delay to any number of events to create or process an alarm.
- (d) Searching and sorting: The alarms and event lists shall be fully searchable and sort-able, in a similar fashion to commercially available spreadsheet software.
- (e) Event list security: The list shall be protected by a password & authorization by the Engineer, so that it shall not be possible for any unauthorized operator or person to edit or delete the event lists.
- (f) It shall be possible to view a historical view as a video on the SCADA operator screen.
- (g) Events are listed in chronological Serial order of Occurrence of Events(SOE).

(17) Play Back Feature

- (a) The SCADA software shall have the feature of playback of data (digital and

analogue signals) from the historical database. It shall be possible to display the stored data on single line diagram. It shall be possible to configure the time window with the parameters: Start Date, End date, Time of Window, and Sampling Rate for playback.

- (b) The software shall include a feature to differentiate the playback display from the normal displays.
- (c) It shall be possible to generate log files from Play back feature for further Analysis.

(18) Tabular Displays

- (a) Tabular displays shall be provided for the following:
 - (i) RTU communication Display
 - (ii) Abnormal summary display — This display will show the points in a station with abnormal status like - off normal status, blocked, manually entered, and not updated
 - (iii) Blocking Summary Display
 - (iv) Tag Summary Display
 - (v) Manual entry summary Display
 - (vi) Operators note summary Display
- (b) From the tabular displays the operator shall be able to locate the point on a single line diagram
- (c) The Tabular Display shall support the following features
 - (i) On line configurable
 - (ii) Multiple data Entry
 - (iii) Sort one or more columns
 - (iv) Filter
 - (v) Sort a filtered list of filter a sorted list
 - (vi) Resizing of columns
 - (vii) Print out the display

(19) Power Block Identification

- (a) Power block for maintenance or inspection shall be granted by the operator / controller in the OCC in pursuance of an approved written down procedure that enables identification of all the authorized and trained personnel granting the block i.e. (the controller of the authorized person requesting the block through a system of passwords & interlocks) and the recipients of the permit to work and precautions to be observed. The Power block shall not be able to be cancelled & section energized unless the permit has been returned by the recipients and the block is cancelled by the person who was granted the block. In case a tele-command is attempted, for energizing the device/ section under block, the command shall be aborted and a hazard message at the OCC and

the RTU shall get generated.

- (b) Granting the power block: The software shall have facility to select the device/section to be brought under power block and kept under power block or to be taken out of power block.
- (c) It shall be possible to select a number of circuit breakers / Interrupters required to be operated for making a section dead and a group command shall be possible to be issued. The system shall be able to open all devices of the sections, which are put under power block by the operator. The closing operation shall be confirmed for each device as an event. The operator shall be able to modify/create such predefined sequences and save. Such operator created programs shall be available only to the creator and not to the other operators. There shall be a function to allow the system engineer to copy user created programs for other operators.
- (d) Operator shall be able to cut off power to a sub-sector by selecting it and giving and confirming the command. The system shall open all the associated switching devices automatically with confirmation for each device as an event.
- (e) The operator shall have to enter the details of the power block like the operator's code number, and time duration of power block. All power block details like operator's identity, time of imposition and section shall be recorded along with system time.

(20) Cancelling the power block

- (a) Only on authorization of the field supervisor having been granted power block, the operator shall be able to select the device or the section on which the block has to be cancelled and give power block cancellation command. With this the power block of the devices/section shall be removed.
- (b) If a power block is not cancelled at the end of the permitted duration, a suitable alarm shall be generated to attract the attention of the operator. System shall not permit the operator to charge until cancellation of the power block.
- (c) It shall be possible to display or print the information of all power block details giving clear details regarding operator's identity, time of imposition and its cancellation. Power block details shall be stored in the database for later use and the switching events.

(21) Under-voltage tripping of SP Bridging Circuit Breakers

Under extended feed conditions, if a low voltage at SP persists for more than a specified time (both of these shall be configurable), an alarm shall be sent to the operator. If the voltage continues to be in the low range even after this time (i.e. operator has not taken any action within specified time to restore normalcy) then the bridging device shall be opened by the concerned RTU through close loop action on voltage limit violation and shall be implemented using ladder logic or IEC 61131-2 control logic. Any override operation shall be possible only through authentication by an administrative head nominated for the purpose.

(22) Data logging and Reports generation

- (a) All alarms and events shall be logged by the system. Average, minimum and maximum values of selected analog parameters shall be stored. The duration of this logging shall be settable and logged data shall be stored automatically with date (year, month and day) and time (hours and minutes) stamp in a file. The software shall be capable of generating different types of reports.
- (b) Some of the reports which may be required are: -
 - (i) Summary of circuit breaker's tripping during a specified period including the relay(s) which caused the tripping;
 - (ii) Power block availed report;
 - (iii) Event and their durations during the month when the voltage went beyond permissible levels at the TSS and SP respectively & parameters of excesses;
 - (iv) Duration during the month when the current exceeded nominal full load capacity of the transformer;
 - (v) Energy data interpretation, Maximum Demand violation;
 - (vi) Morning reports of all the abnormal incidences in the last 24 hours.

(23) Tabular displays, Current & Historical trends diagrams/ graphs:

- (a) The software shall be capable of providing tabular display of data of a controlled station e.g. equipment status, alarms and measurands.
- (b) The time versus value plot of measurands in a separate colour including the arithmetic values on the measurands such as multiplication shall be displayed in a trend diagram. The trending shall include both historical trending and dynamic trending of current data.
- (c) The dynamic (current values) trending shall be for duration of one hour. For historical trend, average value of data shall be logged at the interval of 5 min duration.
- (d) It shall be possible to permit the dynamic values in the forms of graphs to an accuracy of 5%.
- (e) It shall be possible to store historical data of 5 years. If required a separate server may be provided at back end to store historical data.
- (f) However, all data shall be accessible from the main screen where operator normally watch the recent data.

(24) Database creation

- (a) Database creation for the complete system shall be possible through Microsoft Excel based tools or similar. Small addition and deletions of I/O points shall be possible online with minimal disturbance to the Operators.
- (b) Complete system restarts shall not be required for such minor operations.

(25) Bus Bar Coloring:

- (a) The SCADA software proposed shall support necessary bus bar colouring feature by which the dynamic status of the bus bar can be depicted during

charged and dead (discharged) conditions.

- (b) Earthed equipment, blocked equipment, faulty equipment, faulty status, communication failures shall be displayed in separate colours.
- (c) The coloring shall be provided on all screens (overview / individual or sub-picture) at all times.
- (d) The status change shall be reflected through colour change within 2 seconds on the display.
- (e) It shall be possible to give a specific colour to any section based on an intelligent rule.

(26) Application Programming Interfaces (APIs)

- (a) Since other applications for which interfaces with SCADA data may not have been defined at time of tendering (e.g. Fault Call Management etc.) The SCADA, system shall provide open APIs that can be configured at a later date to suit future interface requirements.
 - (i) Objective Data Base Controller (ODBC) support for data interchange between MS-Windows clients like Excel and the real-time/historical databases.
 - (ii) A generic library of services for database access and activation of SCADA procedures and services from external applications.
 - (iii) Support of all APIs in heterogeneous computer environments and to be network transparent.
- (b) A wide range of remote terminal communication protocols for interfacing RTUs and substation control systems from different vendors.

(27) Integrated Graphical & Data Engineering Tool

The integrated graphical & data engineering tool shall provide, as a minimum, following functions:

- (a) Automatic linking of station and network pictures with the SCADA data as part of the data engineering function;
- (b) Support for mass data entry through copy and paste, or excel export import.
- (c) Incremental loading of real-time database.
- (d) Rapid switch over to new database without data loss. Drag and drop support for linking to data base and pictures.

10.12 NETWORK MANAGEMENT SYSTEM

The provision for Network Management at OCC, shall be executed under the scope of Contractor (SYS-1) for the entire Section. The Network requirement and features are being characterized hereunder.

- (a) Network management system to facilitate following activities:
 - (i) Security Management to protect system and network from unauthorized access, manage user access, authorizing privileges.

- (ii) Inventory Management to collect information such as processors, memory, peripherals and processes running of computers/any processor based equipment in SCADA system.
 - (iii) Performance Management to monitor system and network performance as specified.
 - (iv) Fault Management to recognize, isolate, log and identify fault on network and connected machines, nodes, devices.
- (b) The NMS system shall have a simple browser based user interface to provide all the pertinent information about the system. The NMS shall not impact the availability and performance of SCADA.
- (c) The Network management system shall monitor the performance, resource usages and error statistics of all the servers, workstations, routers and switches including the following:
- 1. Utilization (CPU and/or channel time being used as applicable) for
 - (i) Servers, Workstations, Storage Devices
 - (ii) LAN, Router, Switches, Firewall
 - (iii) Data Links
 - 2. Memory utilization, Auxiliary memory I/O utilization of
 - (i) Servers and Other Machines
 - (ii) Mass Storage Devices
- (d) The Network Management Software shall :
- (i) Maintain performance, resource usage & error statistics and present this information via displays, periodic reports, and on demand reports. Apart from real-time monitoring, the above information shall be collected and stored at user configurable periodicities i.e. 5 minutes to 60 minutes.
 - (ii) Maintain a graphical display for connectivity and status of servers and peripheral devices for local area network.
 - (iii) Issue alarms when error conditions or resource usage problems occur.
 - (iv) The period over which the statistics are gathered shall be adjustable by the user, and the accumulated statistics shall be reset at the start of each period.
 - (v) The statistics shall be available for printout and display after each period and on demand during the period.
 - (vi) The user interface provision shall be made in OCC.

10.13 TESTING, COMMISSIONING AND VERIFICATION

10.13.1 General

- (a) Tests shall be performed in accordance with Chapter 8 –Supply, Installation, Testing

and Commissioning of Employer's Requirements General Specifications.

- (b) The Contractor shall develop a full test plan including integrated test and commissioning and performance verification and submit for review by the Engineer at least one month before any on site tests are to be performed.
- (c) On receipt of no objection from the Engineer, the onsite tests as indicated therein shall be performed by Contractor. The tests mentioned herein are indicative and minimum requirement.
- (d) Test Certificates

Six sets of all principle test records and test certificates duly endorsed by the Contractor are to be submitted for the review by the Engineer in accordance with the specifications relating to the item, component or equipment. These test records and certificates shall be supplied for all tests, whether or not the Engineer has witnessed them. The information given on such test certificates shall be sufficient to identify the materials or equipment to which the certificate refers.

10.13.2 Testing of SCADA Equipment

The Scope of Work of SCADA equipment at the OCC and Field level has been specified under preceding Para 10.2 (PS) for Contractor SYS-1. However, the basic requirement of Type test and Factory Acceptance Test, as minimum is as under:

(1) Type Tests and Factory Acceptance Tests

- (a) SCADA equipment shall be offered for factory acceptance tests before dispatch. These tests shall as a minimum comprise of but not limited to the following:
 - (i) Communication Protocol Test: All the important services as per IEC 60870-5-104 and 61850 shall be verified. Vendor shall also supply the necessary test certificates issued from reputed testing agencies for IEC 60870-5-104 and 61850 compliance for the complete SCADA equipment;
 - (ii) The Master station with RTU simulator tool shall be used to test the communication interfaces of Master station, RTU and Protection relays. The Master station simulator tool shall be capable of emulating the master station for IEC 60870-5-104 and IEC 60870-5-103 protocols.
 - (iii) The RTU shall be interfaced with Energy meters on Modbus protocol and displayed with measurands at OCC end in SCADA Single line Diagram.
 - (iv) The RTU simulator shall be capable of emulating the slave protocols for both the IEC 60870-5-104, and IEC 60870-5-103 protocols for Protection relays. It shall also be possible to transmit illegal messages, such as messages having invalid checksum;
 - (v) The protocol analyzer shall be used to monitor all communication traffic on a channel (between Master station & RTU and between RTU & protection relays) without interfering channels operation. Channel traffic captured in the active or passive modes of operation shall be displayed;
 - (vi) RTU functionality Test:

- (a) Visual Examination: RTUs shall be inspected for the features indicated in the specification and the approved Drawings.
- (b) Detailed Architecture and features: Verification of design requirements as stipulated;
- (c) Functional testing on all communication devices including media converters, LAN equipment etc. shall be carried out to verify their operational parameters;
- (d) Transducers accuracy shall be verified over the entire range for linearity and accuracy;
- (e) Functional tests shall be conducted on the power supply unit:
 - (i) Stability of output voltages with the variation of input DC (94-121V) voltage;
 - (ii) With 120% of the normal designed rated load, the voltage regulation and the ripple factor.
- (f) Insulation resistance Tests: Insulation resistance of cables shall be checked without connecting electronic circuits between various circuits, contacts, and terminals with a 500 V Megger. It shall not be less than 5 mega Ohms.

(2) SCADA Software functionality tests:

- (a) All SCADA Software functional features mentioned in this specifications shall be verified,
- (b) Sample SLD's for one station of each type shall be made available and verified for look and feel, ergonomics, and symbols used, interlinking of various Pictures and operation mechanisms, alarm & event log with <1ms resolution,
- (c) Command execution time verification with minimum four online RTU's.
- (d) Status updates time verification with minimum four online RTU's.
- (e) Bus bar coloration performance verification. With minimum four online RTU's.
- (f) Verification of various authorization levels and password protections in the system.
- (g) hot and standby switchover, self-check and diagnostic features etc. shall be verified,
- (h) PC/Servers/Printers for OCC etc. shall be checked as per approved Drawings.

10.13.3 Environment and EMI test on RTU

- (1) The following tests shall be conducted on the offered RTU sub assemblies (cards/modules) or reports of type tests carried out at Government testlabs/institutions/NABL accredited testing labs or any other lab acceptable to Engineer shall be produced.

**Part 2, Section VII-2 : Employer's Requirements - Particular Specifications (PS)-for 2x25 kV, AC
Traction electrification and associated works**

Sr. No.	Title	Standard No.
1	High Frequency test	IEC 60255-22-1, class – III Frequency : 1MHz Damped Oscillatory Longitudinal :5 kVp Duration: 2 sec. Between input current Terminals
2	Electrostatic discharge Direct application and Indirect application	IEC 60255-22-2 Class III and IEC 61000-4-2 class III. Contact discharge: 6kV, Air discharge: 8kV Polarity: both +ve and –ve polarities. IEC-61000-4-2, Class-III
3	Fast transient disturbance	IEC 60255-22-4 and IEC 61000-4-4, class A 1.2kV; 5/50ns; 5kHz burst duration = 15ms. Repetition rate 300ms; Both polarities; Ri = 50Ω; Duration 1 minute
4	Surge immunity test	IEC 60255-22-5 / IEC 61000-4-6 class 4 Differential Mode = 2kV Common Mode = 4kV 1.2/50uS , 5 surges of each polarity
5	Power frequency immunity test	IEC 60255-22-7, Class-A
6	Power frequency	IEC 61000-4-8, Class-V
7	Radiated electromagnetic field disturbance	IEC 60255-22-3 EN 61000-4-3 Frequency 80MHz – 1GHz
8	Conducted Disturbance induced by Radio Frequency field	IEC 60255-22-6 / IEC 61000-4-6: 1996. Freq. 150kHz – 80MHz, Amplitude 10 V, : Modulation 80% AM @ 1 kHz
9	AC Ripple in DC supply Test	: IEC 60255-11
10	Radiated emission:	: IEC 60255-25
11	Dry heat test at 70 ⁰ C in operational condition for 96 Hours.	
12	Damp heat test at 40 ⁰ C and 95 % RH in operational condition for 10 hours.	
13	Cold test at 0 ⁰ C operational condition for 16 Hours.	
14	Cyclic heat test at high temperature at 50 ⁰ C and low temperature at - 2.5 ⁰ C; Dwell time in high or low temperature for 3 Hours. Transition of 10 ⁰ C per minute, and for 5 such cycles in operational condition.	

- (2) The vibration test specified as under shall be conducted on the complete assembled.

- (3) Vibration test with severity of weight centered endurance by sweep frequency 10- 50 Hz, displacement of 0.15 mm acceleration of 2 g and of duration of 2 Hours in each axis. (Total 6 Hours).

10.13.4 Site Acceptance Tests

- (1) Tests shall be carried out during erection/commissioning of the equipment at site on the complete system in the presence of the Engineer to check the proper erection and successful commissioning of the equipment. These tests shall be carried out to check the compliance of the SCADA system with the stipulations made in the specification Drawings.
- (2) SCAN time, cyclic update time and command operation time shall be measured.
- (3) Complete SCADA system working after full configuration shall be verified.
- (4) System response to abnormal conditions shall be verified.
- (5) Site tests shall include tests with different types of simulated faults and with different values of measured parameters. The tests proposed to be performed for this shall also form part of Test Plan to be submitted as per clause 10.13.1 (b) of PS.

(End of Chapter 10)

CHAPTER 11 - INSTALLATION

11.1 GENERAL REQUIREMENTS

- 11.1.1 The Contractor shall comply with all Enactments in executing the Works, including but not limited to all statutory provisions on occupational health, safety and environment.
- 11.1.2 The Contractor shall co-ordinate with Other Contractors in the execution of the Works.
- 11.1.3 The Contractor shall also co-operate with all Relevant Authorities in the execution of the Works.
- 11.1.4 The Contractor shall mobilise a team of competent professionals whose CV shall be approved by The Engineer. The installation of all equipment shall be undertaken at all times by suitably trained and competent employees with previous experience of similar work of the Contractor, to the satisfaction of the Engineer. The Engineer/Employer reserve the right to seek replacement if not satisfied with the qualification of any Professional. Any incomplete submission (not fully complying the educational and experience criterion etc.) of CV of the professional by Contractor shall not be considered as the submission.
- 11.1.5 Only appropriate tools, plant, equipment and vehicles shall be used. The Engineer reserves the right to prohibit the use of particular tools and vehicles.
- 11.1.6 Installation of all equipment shall be in accordance with the Construction and Installation Plan described in Chapter 8 of the General Specifications.
- 11.1.7 Installation of all equipment shall conform to the best industry practices.
- 11.1.8 Precautions shall be undertaken to ensure the safety of personnel and equipment for all installation works.
- 11.1.9 The Contractor shall, prior to starting any installation work, identify any possible hazards, and implement measures of eliminating and/or controlling such potential hazards, in line with safe working practices. These hazards shall be clearly identified in a hazard log that is included in the method statement. These hazards shall be briefed to all site staff at the beginning of each shift. All site staff will sign the briefing sheet.
- 11.1.10 The details on Site safety management are described in the GS.
- 11.1.11 The Contractor shall ensure that all areas of work are sufficiently illuminated for the works to be undertaken and that a safe system of work is employed for all activities as required.
- 11.1.12 The Contractor shall operate a robust system for the control of persons entering or working upon the site. The system shall include as a minimum:
- (1) Register of all employees;
 - (2) Personal identification, with photograph;
 - (3) Levels of competency;
 - (4) Date of issue;
 - (5) Date of expiry;
 - (6) Signature; and
 - (7) Register of all visitors.
- The site identity pass shall incorporate measure to ensure that the pass cannot be easily counterfeited, forged or copied.
- 11.1.13 The Contractor shall co-operate, at all times, with the Engineer and Other Contractors to

ensure that the Site is protected from unauthorized admission, either wilfully or otherwise.

- 11.1.14 The Contractor shall make due provision for the safe access and egress to the Site of Works for its staff and subcontractors. This access shall be maintained such that it is free of all hazards and is in a safe condition throughout the duration of the Works.

11.2 SPECIFIC REQUIREMENTS

The installation work pertaining to this Contract shall include, but not be limited to the following: -

- (1) Finalization of the Construction and Installation Programme;
- (2) Survey on Site and review the technical requirements shown in this Specifications and the Employer's Drawings;
- (3) Production of the calculation sheets and installation Drawings for Site installation;
- (4) Installation in accordance with the finalized installation Drawings;
- (5) Co-ordination with Other Contractors;
- (6) Submission of the installation reports and records;
- (7) Testing and commissioning, as per finalized protocol and programme.
- (8) Production of as-built Drawings, documents, calculation sheets, and records.

11.3 CONSTRUCTION AND INSTALLATION PLAN

- 11.3.1 The Contractor shall undertake installation work in stages as shown in the detailed installation programme. Installation, testing and commissioning of later stages shall not impact revenue operation of earlier stages.
- 11.3.2 As a minimum, the detailed Construction and Installation Plan shall include but not be limited to the activities described above and in GS Vol. I — Chapter 8 on Supply, installation, testing and commissioning. Details of all activities related to installation, methods of installation, equipment, vehicles and tools to be used, safety issues considered supervision and skilled staff to be used for the activity shall be elaborated.

11.4 MATERIAL HANDLING

- 11.4.1 To provide for handling of consignments during construction and also needed during the life of the installation, the contractor shall provide a suitable means or an unloading gantry with a manually operated Chain Pulley hoist of Suitable rating (tonnage) on an unloading platform having the road approach of the switch yard in each Traction Substation, Sub-Sectioning Post and Sectioning Post, as a part of the Permanent Works by Contractor.
- 11.4.2 The Contractor shall provide the approach roads inside the Power supply Control Posts TSS, SSP, SP suited for carrying equipment of highest weight like transformer.
- 11.4.3 The Unloading platform constructed by the Contractor shall also be of same application duty requirement as the heaviest equipment may be unloaded at such platform including for maintenance, if any.
- 11.4.4 The Contractor shall have their own means to shift the material to the worksite including the transportation vehicle and the approach Road connecting to TSS/SSP/SP/ATS (if any)/SS.

11.5 MATERIAL HANDLING PLAN FOR EQUIPMENT

- 11.5.1 The Contractor shall prepare a material handling plan for TSS, SSP, SP, ATS (if any) and SS for movement and installation of bulky items such as transformers, 220/132 kV, AT & 25kV switchgear and OHE Masts/portal, contact wire and catenary wire and other bulky material.
- 11.5.2 The Contractor shall comply with the requirements specified in the GS (General Specifications) in relation to the use of works sites allocated to the Contractor.

11.6 WORKS TRAIN

- 11.7.1 The contractor shall provide sets of High Output Work Trains for construction of the OHE. The sets of work trains should be adequate to commence and continue works simultaneously on all the sections of work as soon as the track access of work site is available. These work trains shall include mast erectors , mast transport, wiring train with platforms for fixing wires and installing droppers and instrumentation for expeditious progress.
- 11.7.2 For use of any Works train, the Contractor shall ensure the safe loading, adequate steps taken against shifting while in motion and ensure that the dimensions of the materials and / or equipment carried under no circumstances shall infringe the Schedule of moving dimensions stipulated for Indian Railways.
- 11.7.3 The Contractor is advised to carefully consider the Works Trains design so that the working platforms have the flexibility to enable the train to pass the height restrictions and yet be of sufficient height for safe and efficient installation of the OHE on site.

11.7 INSTALLATION OF CABLES

- 11.7.1 The Contractor shall co-ordinate with the other Contractors for the installation of cables in cable trenches, ducts, troughs, risers and under track crossings.
- 11.7.2 All the cables laid in the TSS/SSP and SP shall be laid in Covered Masonry/ RCC trenches as per relevant standards, however, at stations or in City/ Municipal/ LocalBodies, the cables may be required to be laid buried under ground. Directly Buried cables shall be laid/ organised as per IS 1255. The Buried cables shall be protected against mechanical damage and water absorption (bricks shall not be less than Class Designation 7.5). Bricks over the cables shall be laid length-wise across the cable route and breadth-wise along the cable route.
- 11.7.3 Cables laid in the trenches shall conform to IEC 61537, IEEE 525. The Cable containment and support system shall conform to IEC 61537.
- 11.7.4 The cable system shall, during installation, be fully protected from mechanical damage and be generally accessible at all points for inspection along its entire route as per IS 1255.
- 11.7.5 Suitable cable markers shall be provided for covered cables upon completion of installation.
- 11.7.6 Should it prove necessary to cut any cable during installation, all cut ends shall be properly sealed until use.
- 11.7.7 The maximum pulling force of any cable during installation shall not exceed the manufactures recommended design force of the cables.

- 11.7.8 The Pull pits shall be provided for directly buried cables, laid in Pipes.
- 11.7.9 All cables shall be laid and suitably clamped in the cable trenches, and for the shafts, under track crossings, hangers, trays and brackets.
- 11.7.10 The minimum manufacturer's recommended bending radius of the cables shall not be exceeded during installation.
- 11.7.11 All materials used for termination, jointing and installation of cables in confined spaces shall have flame retardant, low smoke, halogen free characteristics.
- 11.7.12 Cable joints and terminations should comply with EN 60502, EN 60840 as per the insulation class.
- 11.7.13 The Cable containment and cable sizing designs shall be revalidated with the spacing of cables laid and the cable containment finally executed and suitably corrected for better cable life.
- 11.7.14 The width of under ground cable trench for single cable shall be 350 mm (minimum) and for two cables shall be 450 mm (minimum) and for three cables shall be 700 mm (minimum). Brick on edge shall be laid in between the two juxtaposed cables. On the top protection bricks shall be provided to cover entire width of trench.
- 11.7.15 GI pipes of not less than 75 mm dia, ISI marked and not less than class-B, shall be laid under the railway tracks/roads for crossing the cables.
- 11.7.16 Cable route markers shall be provided along the cable route at locations generally at intervals not exceeding 100 m and on change of direction of cable route and at location of under ground joints. All parts of the route marker shall be galvanized. Route marker shall be grouted in M15 grade concrete cube of size 150x150x150mm and upper most part of cube shall be minimum 200 mm below the ground. On one side "440 volt & danger sign in skull" and on other side HRIDC shall be inscribed. Both sides of route markers shall be painted in yellow colour and shall be submitted for approval of Engineer.

(End of Chapter 11)

CHAPTER 12 - TESTING, COMMISSIONING AND TAKEOVER

12.1 GENERAL

Tests shall be performed in accordance with Employer's Requirements, Part 2, Section VI, Vol-1, Chapter 8 of General Specifications - Supply, Installation, Testing and Commissioning of General Specifications and specifications/ provisions mentioned below:

12.2 CONTRACTORS RESPONSIBILITIES FOR ON-SITE TESTING

The contractor shall submit Test Plan for Total system as well as for different subsystems (TSS, SP, SSP, OHE, SCADA etc.) and major equipment (Switchgear, Transformers, CT, PT, Cables, Control Panels, Distribution Board, Battery and its charger, Isolators etc.) in accordance with:

- (i) Relevant Indian standards;
- (ii) Tests as given in the applicable Standards for equipment / Subsystem;
- (iii) Manufacturer's recommendations for tests after installation.

The Test Plans should include but not limited to:

- (i) Test to be performed furnishing a list of the tests identified in the relevant Standards and Technical Specifications and Tests Proposed to be carried out and witnessed with break up in to FAT, Site tests and Acceptance Tests,
- (ii) Test Procedures for each test proposed including precautions to be taken during tests,
- (iii) Test equipment/ instruments and measuring instruments to be used,
- (iv) Parameters to be checked,
- (v) Criterion for acceptance / rejection, acceptable Values,
- (vi) Test Program
- (vii) Any other relevant information,

The tests shall be conducted after the test plans have been approved. Record of such tests with observations and obtained result shall be maintained.

- 12.2.1 Traction Power Energisation of the track shall be carried out progressively in stages. For the energisation of section (including tunnels) in stages, sectional turn-on of 25 kV AC power may require putting up of temporary works e.g. cable diversion, additional earthing provision, etc. to ensure the safety of workers working in the adjacent area. Such work inclusive of sectional testing of traction power shall be deemed to be included in the scope of Contract. The OHE (and ROCS in tunnels) commissioning shall include as a minimum in conformance to EN 50119/ relevant standards and the guidelines specified in ACTM and specified by RDSO :

- (1) **Visual inspection:** This shall include check for accuracy of construction for ensuring that all the structures, equipment, insulators, jumpers and conductors have been erected as provided in approved Drawings and they are not damaged and remain in healthy state.

- (2) **Dimensional Checks:** This shall include dimensional checks to ensure the execution of permanent Works are within the limits of tolerance permitted so as to permit the current collection by locomotives to be satisfactory.
- (3) **Final Physical Check**
This shall validate as a minimum that all temporary earths are removed, wires are present and in good condition, nothing is fouling with the OHE/ROCS and all insulators are undamaged and present and auto-tensioning devices are installed and are functional. All sections of OHE/ROCS spans are provided with connectivity jumpers.
- (4) **Earthing and bonding**
All earthing and bonding arrangements have been completed.
- (5) **Section proving**
This test shall be undertaken in each electrical section, to ensure that each electrical section can be successfully isolated from adjacent electrical sections and that the correct OHE alive indications are shown in the TSS control rooms and the on the SCADA system.
- (6) **Clearance for Test Charging**
The contractor shall ensure that all equipment, tools and M&P are removed from the site and the OHE/ROCS Equipment are free from any hindrance, physical obstruction, and is safe for personnel, before seeking clearance from the Engineer for test charging.
- (7) **Anti-Theft Charging of OHE**
- (a) As an anti-theft measure, the OHE after erection shall be charged at 2.2kV by the Contractor. All arrangements for taking supply from the supply authority or otherwise shall be done by the contractor. However, before such anti-theft charging safety of Personnel of all the contractors and of Employees of adjacent Railway System has to be ensured. This includes:-
- (i) Permission of the Employer.
 - (ii) E.I.G. Sanction,
 - (iii) Appointment and Placement of authorized personnel.
 - (iv) Issue of public notice in Local Newspapers for information to public.
 - (v) Notice to adjacent Indian Railway Administration.
 - (vi) Procedure providing for issue and cancellation or permit to work on or in vicinity (within two meters of the conductors & 25 KV equipment) to all concerned through and to authorized Personnel as a requirement before the lines can be charged as an anti-theft measure. The list of authorized Personnel shall be approved by the Engineer and provided to all the concerned authorities. Procedure of issue and cancellation or permit to work shall be approved by Engineer.
 - (vii) Control Room for 24X7 hour monitoring of the charged sections and its patrolling. Communication facility to enable monitoring of the OHE and management of Permit TO Work (P.T.W.).
 - (viii) Issue of certificate to authorized Personnel for charge & discharge of line.

(ix) Communication with patrol party and control room.

(x) Attending to alarms.

(b) The contractor shall give notice to all the designated Contractors, who will take necessary precaution while carrying out the works keeping in view the anti-theft charging of OHE. This antitheft charging shall not be done until "no objection" is received from the Engineer and confirmation received from him that IR staff of adjacent linking station and DFC linking station have been warned of the hazards of adjacent line of HORC being charged and have been trained on the precautions required to be taken by them.

(c) Detailed rules shall be prepared by the Contractor and put up to the Engineer for approval & issue to all concerned.

(8) Tests Prior to Commissioning of a section

(a) Short circuit testing

Each electrical section shall be subject to electrical short circuit test at the remote end under normal feeding and one short circuit using the extended feeding arrangements. This test shall confirm the mechanical integrity of the OHE and validate that the substation protection systems function correctly.

(b) Steady current tests.

The steady current test shall be undertaken in each block between TSS and the adjacent TSS. This test shall be used to validate the EMC safety case, validate protection system and to confirm the currents in earthing and bonding cables and to allow the measurement of accessible voltages at strategic point in each electrical section.

12.2.2 The Contractor shall not energize the TSS, SP, SSP, SS or the OHE until all interfacing parties have issued a letter of no objection. Once all interfacing parties' letters of no objection have been received then the Contractor shall apply to the Engineer to seek a letter of no objection to proceed with Energisation of the electrical section.

12.2.3 The Contractor shall be responsible for surveillance and security of the power supply systems including padlocking or otherwise maintaining control of the substation, padlocking of Switchgear and circuit breaker units, distribution switchboards, power panels, etc. throughout all Energisation stages of the installation.

12.2.4 The Contractor shall interface with the other Contractors to ensure no downstream cables or other electrical equipment is energized before it has been tested and before other involved Contractors facilities are ready and secured.

12.3 RE-TESTING

12.3.1 When defects are detected in the equipment accessories, etc. during the commissioning tests, the Contractor shall ensure that adequate spares are kept on site to promptly attend to such defects.

12.3.2 In the event of the defect on any item being of such a nature that the requirements of these Specifications cannot be fulfilled by adjustment or modification, such item shall be replaced by the Contractor at his own expense, after carrying out the tests as per the relevant specifications for acceptance by the Engineer.

12.4 INSTALLATION TESTS

12.4.1 An inspection and visual verification of ratings and connections of equipment, instrument transformers and auxiliary circuits, installation tests shall be carried out.

12.4.2 After installation of equipment, visual inspection and operational tests on un-energized equipment shall be carried out to check the following:

- (1) Cleanliness;
- (2) Workmanship;
- (3) Confirmation of items conforming to ratings specified;
- (4) Water and dust proofing;
- (5) Leveling, mounting and positioning;
- (6) Joints and connections tightness;
- (7) Cables – dressing, bending radii, jointing and finish at terminals;
- (8) Clearances and dimensions in conformity with Drawings;
- (9) Earthing and bonding;
- (10) Functioning of circuit breakers, isolating switches and their interlocks;
- (11) Protection devices;
- (12) Phase sequence verification;
- (13) Conforms to as-built records.

12.4.3 Earth resistance measurements shall be carried out individually for the subsystem and the system as required.

12.4.4 Insulation Resistance

The Insulation resistance of all 220/132 kV ac and 25kV circuits shall be tested with an Insulation tester of 5 kV. All LV circuits comprising ac and dc auxiliary circuits shall be tested with a 500 V Insulation tester.

12.4.5 Continuity Test and Contact Resistance

Continuity of all circuits shall be verified. Contact resistance of all high current joints and bolted contacts, especially the joints of 25 kV conductors and the running rails for return current shall be measured with a Ductor set with a resolution of $1\mu\Omega$. Earth system joints shall also be measured.

12.4.6 Protection Equipment

(1) Tests on Current Transformers

- (a) Insulation resistance
- (b) Winding resistance
- (c) Polarity or Connections up to equipment terminals.
- (d) Ratio and magnetization curve verification

(2) Tests on Voltage Transformers

- (a) Voltage ratio
- (b) Insulation resistance

(c) Polarity of connections up to the equipment terminals.

(3) Secondary and primary injection tests

Tests shall be carried out at a minimum of three settings if multiple settings are available. Test results of operation boundaries and operating times shall be recorded.

(4) Batteries and Chargers

(a) Discharge tests and charging tests shall be carried out to verify the capacity of the batteries and all functions available on the charger.

(b) Continuous measurements of battery voltages shall be made together with periodic readings of the electrolyte specific gravities and temperatures.

(c) No addition of electrolyte is permitted during discharge tests.

(d) The operation of the boost charge facility and the effect of the voltage dropping diodes shall also be demonstrated.

(5) Control, Indication and Alarm Functions

(a) Insulation resistance and continuity of all cores of cables shall be identified and tested.

(b) The correct functioning of all control, indication and alarm devices shall be verified.

(6) Switchgear

(a) All switchgear, including circuit breakers, interrupters, isolating and earthing switches, shall be operated to prove that the operating gear, tripping devices, protective gear and mechanical interlocking are satisfactory.

(b) SF6 gas leakage test shall be performed where applicable.

(c) Closing time for all circuit breakers shall be verified.

(7) Instruments and Transducers

All current and voltage transformers, metering instruments and transducers shall be calibrated by voltage and current injection to prove their accuracy classes.

(8) Power Transformers

(a) Voltage ratio at all taps, functioning of tap changers and Insulation measurements shall be performed.

(b) Oil circulation and oil testing shall be performed.

(c) Simulation tests shall be carried out to determine correct operation of all protective relays.

(d) Test shall be undertaken in accordance with those set out in the Transformer specifications in chapter 19 Appendix – 8 & 9 of PS.

12.5 PARTIAL ACCEPTANCE TESTS

12.5.1 These tests form part of on-site and System Acceptance Tests as part testing of the equipment and system.

(1) Functional Tests and Interlock Tests

(2) All control and protection functions and electrical/mechanical interlocks shall be

tested.

(3) **Primary Injection Tests**

The Contractor shall carry out primary injection tests on each protective system, to prove the auxiliary circuit connections, the relay fault setting values, the correct metering indications and the stability limits.

(4) **AC/DC Pressure Tests**

(a) The Insulation resistance of all circuits shall be measured before and after the dc pressure test. The minimum phase-to-phase and phase-to-earth Insulation resistance shall be as per relevant standards.

(b) Pressure tests shall be carried out on completed cable lengths of highvoltage cables in accordance with IEC 60502.

12.6 SYSTEM ACCEPTANCE TESTS

12.6.1 Energisation

(1) The Contractor shall prepare operation safety rules and procedures for the review of the Engineer before Energisation.

(2) The Contractor shall carry out all necessary checks to ensure safe Energisation.

(3) The Contractor shall be responsible for the operation of traction and auxiliary power equipment. Upon request by the Engineer, the Contractor shall be responsible for the disconnection and the subsequent reconnections of the power equipment or of overhead equipment or connections of traction lines.

12.6.2 Tests

System Acceptance Tests shall include but not be limited to:-

(1) Functional tests of SCADA system

(2) Integrated Tests with Engineer's Train Operator

(3) Short Circuit Tests on OHE

Short Circuit Tests on 25kV overhead lines shall be carried out to prove correct operation of protection equipment and to ensure that the dynamic strength requirements of overhead equipment are met. Short Circuit Tests shall be carried out on every overhead equipment line feeder (OHE to Earth, NFW to Earth, OHE to NFW, OHE to ballast and NFW to ballast). Contractor shall submit method statement of short circuit test for review of Engineer.

(4) **Current Collection Test**

The contractor shall conduct current collection tests as per EN 50317 to demonstrate that newly installed OHE satisfies the quality requirement for maximum test speed. The behavior of the OHE shall be watched at various speeds. Current collection shall be considered unsatisfactory, if any blue flash/ spark is observed, indicating that the contact between the pantograph and contact wire is not smooth. In such cases remedial action shall be taken to rectify and restore smoothness in the contact wire.

(5) **Dynamic Validation**

(a) Dynamic validation shall be undertaken to ensure compliance with the specified current collection criteria of all relevant parts of the work including

track work, rolling stock and catenary interfaces.

- (b) The criteria for measurement shall be loss of contact with measurable arcs lasting longer than 10ms (maximum 25ms) shall not occur more than once in 100m.
- (c) The Contractor shall agree with the Engineer the selection of a suitable method and equipment, which determines compliance with the current collection standard within the range of operating conditions.
- (d) The system dynamic performance shall comply with the requirements of EN 50119.

(6) Earth Fault Test on OHE

Earth fault tests shall be conducted on OHE traction wires and feeder wires to prove correct operation of protective equipment as described in ACTM. The fault distance from nearest operational circuit breaker shall be validated during the test.

12.7 INTEGRATED TESTING AND COMMISSIONING

12.7.1 Integrated Testing and Commissioning refers to those tests undertaken in order to demonstrate that the various components of the railway systems operate satisfactorily between one another and meet all specified requirements for design, operability, safety, and integration with other works and systems. Integrated Testing and Commissioning shall comply with the requirements of EN 50317, EN 50367, IEC 62427 and IEC 62313.

12.7.2 These tests shall be entirely within the requirements of one or more of the Project Contracts or they shall involve a multiplicity of Contract procedure. The final Integrated Testing and Commissioning shall be carried out after the SCADA system and OCC have become operational.

12.7.3 Those systems that can be tested without depending on the running of trains, such as SCADA system, etc. will have their integration tests scheduled to commence as early as possible. It is preferable that any interface problems associated with these "train less" system tests be identified and resolved prior to the commencement of test running.

12.7.4 The following is an indicative listing of those Integrated Testing and Commissioning functions that are necessarily to be integrated with others to demonstrate that the equipment and controls installed therein meet the Contract Specifications and demonstrate a safe-to-operate condition. This list is not exhaustive and the same shall be updated by the contractor, to demonstrate functionality, completeness and safety of the installed works. The updated list shall be approved by the Engineer

- (1) Load sharing test between traction transformers during train acceleration.
- (2) Load measuring test for circuit breakers.
- (3) Harmonic measurement.
- (4) TSS, SSP, SP and SS failure mode test.
- (5) Remote control and monitoring test through SCADA system at OCC.
- (6) Power system functional tests.
- (7) EMI/EMC tests.
- (8) Touch/step potential tests (in TSS/SSP/SP and in OHE/ROCS).

12.7.5 On-load Tests and Directional Tests

Once sufficient load current is established, voltages and currents into protection and metering equipment shall be verified to ensure correct operation of protection relays and accuracy of meter readings at local and remote locations.

12.8 SERVICE TRIALS

The Contractor shall provide special and general attendance during the Service Trials period such that the persons who carried out the On-Site Testing and Commissioning are available on Site to solve any problem arising from the Service Trials.

12.9 PERFORMANCE VERIFICATION

- 12.9.1 The Contractor shall carry out all Performance Tests to verify that the performance of the System meets the Employer's Requirements after substantial completion of the Works.
- 12.9.2 The Performance Tests shall be carried out by the Contractor in conjunction with relevant parties (e.g. Indian Railways).
- 12.9.3 The measurement of EMI levels shall be carried out prior to Energisation of the Traction Power System, and then during Service Trials and commercial operation of the train services to ensure that the EMI levels comply with the requirements of these Specifications.
- 12.9.4 Should the performance of the System deviate from the Particular Specifications, the Contractor shall make every effort to rectify the deviation in the shortest possible time, and to the satisfaction of the Engineer.

12.10 TRACTION INSTALLATION TAKE OVER

- 12.10.1 The conditions for Takeover of the Traction installation are as follows:
- (1) The Contractor shall hand over the HORC sections of the traction installation to the Engineer on the Co-ordination Dates as per Conditions of the Contract. From this date, any access to the Railway Installation by the Contractor shall be in accordance with any procedures, requirements and conditions laid down by the Engineer.
 - (2) At the time of Takeover, the Contractor shall have executed all the works of Employer's requirement as described in GS and PS (Volume 2) including structures, all safety works, screens, barriers from High Voltage and affixed all Safety and Warning Sign boards and all other works provided by the Contractor within the Railway Envelope, the installation of all equipment and fixings defined under relevant chapter(s) and shall ensure that the Envelope is complete, secure, safe for the operation of trains, and has the Engineer's approval for effective Takeover.
 - (3) Prior to the issue of Taking Over Certificate, the Engineer will ensure the completion of following activities:
 - Testing of traction equipment and other equipment and facilities required for operation of the railway.
 - Acceptance tests and Integrated System Tests;
 - Trial running: during this period the Engineer will be operating trains and equipment on a trial basis, the frequency of which will increase as the trials

proceed until full operating frequencies & performances are achieved.

12.10.2 The conditions for access to the HORC Railway Envelope after handover are as follows:

- (1) Access to the HORC Railway Envelope after takeover will be controlled by the Engineer. Access will be given to the Contractor and to other contractors by the Engineer for inspecting, maintaining, adjusting and repairing, by prior arrangement and for limited periods. The work on High Voltage sections will be subject to 'Permit to Work' procedure.
- (2) At the time of Takeover, the Contractor shall nominate a responsible In-charge and a person contactable on twenty-four (24) hour basis to liaise with the Engineer during Defect Notification Period. The Contractor shall give two weeks' notice of his desired track and /or High Voltage equipment possessions, and, when requested, at the appropriate meetings, track possession and or Traction Installation possession allocations will be made by the Engineer. It may be necessary for the Contractor's work to be carried out intermittently or at night, if suitable possessions cannot be given during its preferred hours. During all such operations the Contractor will be fully responsible for safety of men, equipment and Works.

12.10.3 The Contractor shall take into account of the Engineer's activities and train operations in planning and programming its Works.

- (1) The conditions for access to the HORC Railway Envelope on the Work Site after issue of Taking over Certificate on completion will be administered by the Engineer.
- (2) Prior to the substantial completion of the Works, the Contractor will be given extended possessions of the Railway Envelope for the purposes of final adjustment, tightening, touching up or cleaning up prior to the final inspection of the Works. Such possessions shall be agreed with the Engineer.
- (3) Safe Earthing and Bonding of the Traction Installation, screens and access barriers against exposure of 25 kV ac, supply to public and unauthorized personnel etc. as required in terms of safety provisions of relevant standards and safety regulations shall be supplied and installed by the Contractor before the Takeover of the Traction Installation by the Engineer.

(End of Chapter 12)

CHAPTER 13 - SPARES, SPECIAL TOOLS, TESTING & DIAGNOSTIC EQUIPMENT AND MEASURING INSTRUMENTS

13.1 GENERAL

- (1) The Contractor shall supply the spares as detailed in Table No. 13.2.1 below, not later than Six weeks before the start of Defect Notification Period to ensure availability.
- (2) In addition, the Contractor shall submit to the Engineer a Schedule of Recommended Spares including consumable, duly indicating for each item, description, part number, drawing number, lead time, shelf life and number of units having due regard to the lead time of respective Spares.
 - (a) The Contractor shall base the spares calculations on the reliability and availability data and the criticality of the equipment and submit these calculations to the Engineer for review.
 - (b) The Schedule of Recommended Spares shall:
 - i be grouped by plant & equipment, manufactured items and system/sub-system, test equipment and special tools as applicable for stocking identification;
 - ii Have detailed description with drawing references and correlation with the maintenance manuals.
- (3) The Contractor shall submit the name(s) & address(s) of primary and secondary source(s) of all the spares, who shall supply the spares and consumables.
- (4) In the event that any of the spares identified have a particular shelf life or special storage requirement, this shall be made known to the Engineer with the submission including the necessary action for disposal or storage.
- (5) All spares shall conform to Identification and Configuration Control requirements established by the Contractor for the equipment provided under the Contract.
- (6) Testing of the Spares - The Contractor shall ensure that all spares are correctly calibrated, tested and labeled prior to their delivery. Test/Calibration Certificates for each one of the spares shall be submitted to the Engineer.
- (7) All kinds of consumable not limited to printer cartridges, tapes and papers etc. shall be supplied by the Contractor for the period upto the handing over of the Work to the Employer.

13.2 CONTRACT SPARES

The Contractor shall supply Spares as given below.

Table 13.2.1: Quantity of Contract Spares

S. No	Item Description	Quantity
A1. OHE Spares		
1	All types of structures including portal parts	2% of each type used for the project subject to min of 10 nos. and Maximum of 20 nos.
2	catenary and contact Conductors, Fittings, hardware and all types of Jumpers & droppers	2% of Installed quantity Km
3	Set of Cantilever Brackets with insulators	50 nos.
4	9-T insulators	75 nos.
5	Feeder Conductor	2 kms
6	Aerial Earth Wire and BEC (if required)	10 km each
7	OHE Section Insulators	10 sets
8	OHE Auto-tensioning device sets	10 sets
9	Counter weights for ATD	10 sets
10	Stainless steel wire rope for ATD	20 sets
11	PTFE type Neutral Section	5 sets
12	Splices for conductors, feeders	10 nos. for feeder wire 50 nos. for Contact wire, 50 Nos. for Catenary Wire and minimum of 10 nos. of splices of each type of other conductors used such as Large Span wire etc, AEW, BEC (if required).
13	Spares for OHE other than above (1 to 12)	2.5 % subject to minimum 10 nos. and subject to quantity in whole nos. next higher no/ weight for hardware items
A2: ROCS Spares		
1	Conductor Rail	500 m
2	Support (drop arm) assembly cantilever arm along with swivel head, anchor bolts, support insulator bolts with all hardware complete (except support insulator)	20 nos.
3	Support Insulator	50 nos.
4	Anchor assembly	2 nos.
5	Expansion joints	2 nos.
6	Air gap section	2 nos.
7	Transition arrangement	4 nos.
8	ROCS protection cover	10 nos.
9	Conductor rail expansion joint jumpers with fasteners	2 sets
B : PSI (TSS,SP,SSP) - Spares		

**Part 2, Section VII-2 : Employer's Requirements - Particular Specifications (PS)-for 2x25 kV, AC
Traction electrification and associated works**

1	LA for 220/132 kV	2 nos each type.
2	LA 42 kV	5 Nos.
3	25kV PT	5 Nos.
4	25kV CT	2 each type
5	Double pole Interrupter 55/2x25kV	2 Nos.
6	Double pole Isolator motor operated 55/2x25kV	4Nos.
7	Double pole CB 55/2x25kV	2 Nos.
8	220/132 kV CB	1 no.
9	220/132 kV CT	1 no.
10	Isolator 220/132 kV	1 no.
11	String insulators 220/132 kV	2 sets
12	Post Insulators 220/132 kV	2 nos.
13	Post Insulators 25 kV	20 nos.
14	Auto Transformer	1 No suitable for TSS and 1 no suitable for SP/SSP on short circuit capacity)
15	Auxiliary Transformer 100 KVA	1 nos.
16	Auxiliary Transformer 50 KVA	2 nos.
17	Auxiliary Transformer 25 KVA	4 no.
18	CTs, PTs and other Accessories as used for the project	Minimum 5% subject to Minimum of 3 nos.
19	PSI (TSS, SP, SSP) - Spares other than item 1 to 18 above (connectors, jumpers, hardware, bus bars etc.)	5 % subject to min of 3 nos./ meter/kg and max of 10 nos./ meter /kg
20	Spares of Auto transformer	As per list of spares included in the specification given in relevant Chapter for required rating.
21	Spares of traction transformer	As per list of spares included in the specification given in relevant Chapter for required rating.
C. Protection and Metering		
1	Control and auxiliary relays	1 set of each type
2	Protection relay	1 set of each type
3	Metering Relay	1 set of each type
4	Transducers	1 set of each type
D. SCADA System		
1	Spare Cards for RCC/RTU	Minimum 20% spare cards but not less than Five of each type
2	Spare Cards of Each type	20% spare cards but not less than Five of each type at the time of Handing over

13.3 SPECIAL TOOLS, TESTING AND DIAGNOSTIC EQUIPMENT AND MEASURING INSTRUMENTS

- (8) The Contractor shall submit a schedule of recommended Tools and Test equipment with details of calibration and supplier(s).
- (9) The Contractor shall supply at least six weeks before the start of Defect Notification Period, the Tools and Test Equipment for various Systems/Sub- Systems, which are essential for day to day use in both corrective and preventive maintenance and for workshop use in repairing of modules/units.
- (10) The Contractor shall supply the Tools and Test Equipment as detailed in table 13.3.1 and 13.3.2 below.

Table 13.3.1: List of Special Tools and Instrument

S. No	Description	Quantity in No's
1	Cable Fault Locator	1 sets
2	AC Power Line Analyzer	2 nos.
3	Digital earth testers	3 nos.
4	Earth Leakage Detector 1000 V	3 nos.
5	Digital Insulation Tester 2.5/ 5 kV	3 nos.
6	Digital Insulation Tester 0 – 1000 V	3 nos.
7	Dynamo Metre (5.0 T x 20 Kg)	1 nos.
8	Binoculars	1 nos.
9	Vernier Caliper	1 nos.
10	Walky Talkie Set	6 nos.
11	Emergency Telephone	7 nos.
12	Primary injection test kit	1 nos.
13	Secondary injection test kit	1 nos.
14	Relay Testing Kits	1 nos.
15	Infra-red remote temperature sensor	2 nos.
16	Fully automatic Oil dielectric test kit with printer	1 nos.
17	i) Thermal Imaging Camera capable of being mounted on Tower Wagon /loco ii) Hand held Thermal Imaging camera	2 nos. 2 nos.
18	Video Camera	2 nos.
19	Height and Stagger gauge (instrument laser based)	4 sets
20	Dissolved Gas Analyzer set	1 nos.
21	Hydraulic Compressor for Aluminum conductor Splicing Zig (all sizes)	1 sets
22	Turfers all weight categories	10 each type
23	Pull lift all weight category	10 each type
24	Come-along clamps for different conductors	20 for each size
25	Discharge Rod complete including earthing cable and connectors	20 nos.
26	Aluminum Ladders (5 m and 11 m extendable)	15 each
27	Portable petrol/ kerosene set 1.5 KVA	5 nos.
28	Vehicle mounted Oil filtration plant 1 phase 3000 liters per hour capacity	1 nos.
29	Portable diesel Generating set 3 kVA 230 V.A.C.	2 nos.

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30	150 sq.mm Contact wire Cutter 36"	10 nos.
31	Wire Cutter 12"	10 nos.
32	"D" Shackle set (1",3/4", 5/8", &1" One Each)	20 nos.
33	Single sleeve Pulley Block 3.5" x 5/8" Groove Fiber for drawl of contact. &catenary wire	20 nos.
34	Portable rail drill machine.	5 nos.
35	Siren 3 phase Range 5 Km and 1 phase Range 1 Km	2 each
36	Ladder Trolley capable of running on track	2 nos.
37	DE and Ring Spanner sets suitable for Fittings being supplied	20 nos.
38	Chain pulley block all weight category as required for erection	10 nos.
39	Hydraulic insulator testing jig	2 nos.
40	Copper Hammer	5 nos.
41	Nonmetallic Hammer	2 nos.
42	Micro Meter	5 nos.
43	Fiber measuring Tape 30 mtr. & 15 mtr. Each	10 nos.
44	Isolator pad lock	10 nos.
45	Neutral Section inspection Jig	2 nos.
46	Nylon rope 20 meters length	10 nos.
47	Diagnostic kit (LAPTOP) along with software capable of testing all type of modules to identify Faults	3 nos.
48	Digital Multi-meter	3 Nos
49	Portable operated tree pruner	5 Nos
50	Motorised Earth Augur	2 Nos
51	Crimping Tools for droppers/ conductors (all types)	10 Nos
52	Operating rod for DO fuse (Pull Rod)	5 Nos
53	Inflatable lighting tower	3 Nos
54	Portable Power hacksaw	3 Nos
55	Safety Helmet	50 Nos
56	Safety Harness	10 Nos
57	Hand blower	2 Nos
58	Vacuum Cleaner	2 Nos
59	Vehicle mounted Oil filtration plant 1 phase 300 liters per hour capacity	2 Nos
60	Box spanner set	3 Nos
61	Portable Tan Delta & Capacitance Measuring Bridge	2 Nos
62	Capacitance meter	2 Nos
63	Portable grinder Electrically operated	2 Nos
64	Steel sling with eye each end 1 m, 2 m and 3 m	10 each
65	Steel sling with eye each end 5 m, 10 m	5 each
66	Twister cum bender 6"	10 Nos
67	Motor Trolley	2 Nos
68	Unmanned Aerial Vehicle (drone) flight time not less than 30 minutes	1 Nos
69	Oliver – G	1 Nos

Table 13.3.2: Tower Wagon

S. No	Description	Quantity in No's
1	8 Wheeler Tower Wagon as per RDSO's specification TI/SPC/OHE/8WDEIC/0092(08/15 Rev.2 or latest specification	1 No.

Contractor shall place purchase order for 8-Wheeler Tower Wagon within 90 days from Commencement Date.

13.4 TECHNICAL SPECIFICATIONS FOR SPECIAL TOOLS, TESTING AND DIAGNOSTIC EQUIPMENT AND MEASURING INSTRUMENTS

The specifications of few special tools and diagnostic equipment are summarized hereunder. This list of specification is not exhaustive and may not cover all the tools, equipment and instruments. The contractor shall submit a schedule of recommended Tools and Test Equipment along with technical specifications in detail for the approval of the Engineer.

- 13.4.1 **Cable Fault Locator** - Voltages up to 0 ... 12 kV, display of end and fault distance, display at least 5" size, DC Hipot Function, ARM Method, Direct Thump Method, TDR Function, Sheath Test, Sheath Fault, Integrated Battery, Truly portable, rain proof and low weight, TDR options in both operational modes, QUICK-STEPS and EXPERT Mode shall be individually programmable by customer. Fault location by the magnetic field and sound signal coincidence method, Excellent acoustic characteristics (frequency range 100 Hz to 1.5 kHz).
- 13.4.2 **Earth Leakage Detector** - Range: 0-30 mA/300 mA/30 A/300 A, 0.01 mA resolution for measuring earth leakage currents, Jaw Opening 40 mm, Analogue Bar graph Display for trending, 300 V phase to earth and 500 V phase to phase CAT III or 600 V CAT II double insulated, Safety - IEC1010-1, EMC-IEC61326-1.
- 13.4.3 **Earth Megger** - 20 kilo ohms with 1 ohm Resolution with accuracy ± 0.5 %, Test Frequency: 105 - 160 Hz in 0.5 Hz Steps, Test Current : 50 mA, Maximum Output Voltage: < 50 Vrms, Maximum Interference: 40 Volts Peak to Peak (50 Hz), Measurement Standards: BS: 7430 (1991) and VDE 0413, Part 7, IP54, Safety - IEC1010-1, EMC-IEC61326-1.
- 13.4.4 **Digital Megger 10000 V** - Mains (without battery) operation & rechargeable battery operation, 35TOhms, Short circuit current 6 mA, noise rejection 8 mA, Guard out parallel leakage resistance with a max error of 2%, IP65 rated & CAT IV rating, Safety - IEC1010-1, EMC-IEC61326-1.
- 13.4.5 **Primary injection test kit** - 2000Amps @3 minutes, Open circuit voltage 6V, fine adjustment knob (Variac) on control panel with inbuilt display, positive and negative buttons for coarse adjustment of current, Design of test set should be based on transformer technology and not on spire (hole) through technology for better efficiency.
- 13.4.6 **Secondary Injection Test Kit** - Output AC Current 250A, AC Voltage 250V, DC Voltage 0-300V, 0-359deg, 15-550Hz, Plotting excitation curves, Current and voltage transformer ratio tests, Burden measurement for protective relay test equipment, Impedance measurement, Efficiency tests, Polarity (direction) tests, CE-marking, Weight should not

exceed 19Kg.

- 13.4.7 **Relay Testing Kits** - Modular in Design, 6 current source - 3 X60A + 3X15A, 4 voltage sources out of which 3 are convertible to current sources - 3x300V, Max Compliance voltage L-N 50V and L-L 100V, Power Consumed 1800VAmx, Manual Control LCD Touch Screen, IEC 61850 Testing Capability, Safety - IEC1010-1, EMC-IEC61326-1.
- 13.4.8 **Oil dielectric test kit** - BDV 100KV with inbuilt oil temp measurement, HV switch off time shall be <10us , external calibrator, Safety - IEC1010-1, EMC-IEC61326-1 Class B.
- 13.4.9 **Tan Delta Kit** - Voltage 25V-12kVAC, inbuilt voltage dependency detection, automaticPF Tip up test, generate its own temperature correction factor by using variable frequency method from 1hz to 500hz, Safety - IEC/EN 61010-1:2001, EMC - EN 61326:1997/A1:1998/A2:2001/A3:2003.
- 13.4.10 **Measurement of Moisture in Paper by Frequency Domain Spectroscopy** - Output Voltage 200V, Output current 50mA, Frequency range 0.1mHz - 10kHz, Excitation current Measurement, Tan Delta measurement @50 Deg, Oil conductivity, Measurement time upto 1mHz would be around 22minutes, Measurement time upto 2mHz would be
- 13.4.11 **Sweep Frequency Response Analyser** - Frequency range 0.1 Hz — 25 MHz, No. of points Up to 32 000 points, user selectable, inbuilt Battery, 0.20 — 20 V peak to peak compliance voltages, Fulfils requirements in IEC 60076-18, IEEE C57.149-2012, CIGRE Technical Brochure 342, DL/T 911-2004, external calibrator, Safety - IEC1010-1, EMC-IEC61326.
- 13.4.12 **CT Analyser Kit** - Multi tap (suitable for up to 5 taps) analyzer, Ratio measurement, polarity, CT secondary resistance measurement, Excitation characteristics plot, CT burden testing, IR testing, Single Phase relay testing, standard testing procedure like IEC60044-1,6, IEC61869-1, IEC61869-6 ANSI45,30, Safety - IEC1010-1, EMC- IEC61326.
- 13.4.13 **Transformer and Sub-station test system** - Automated 3Phase/6winding measurement for Turns Ratio, Winding Resistance (100A/50V), Demagnetization, Load tap-changer continuity, timing and dynamic resistance measurement, Excitation Current, Leakage Reactance, FRSL and Magnetic Balance Measurement, Single Phase testing of primary and secondary relays, AC Insulation testing with frequency range of 1 - 505 Hz with Intelligent Temperature Correction. Primary Injection Test up to 800A, Contact Resistance Measurement up to (100A/50V), Display of the unit must be 10.4" TFT touch type with 1024x768 resolution CE- marking.

(End of Chapter 13)

CHAPTER 14 - RELIABILITY, AVAILABILITY, MAINTAINABILITY, AND SAFETY

14.1 GENERAL

The Project is to be designed with high degree of reliability and availability as per Employer's Requirements, Part 2, Section VI, Vol-1, and Chapter-12 on- Reliability, Availability, and Maintainability & Safety (RAMS) of General Specifications and as per specifications / provisions mentioned below:

- 14.1.1** The Contractor shall demonstrate that the traction power supply and OHE/ROCS system shall meet all the RAMS requirements specified for this system. These specifications define a set of RAMS requirements for the Electric Traction System to be used, assessment and controls of threats to RAMS, Plan & Implement RAMS Tasks, demonstrate achievement of adequate Reliability, Availability, Maintainability & Safety (RAMS) Assurance. This includes the setting up a monitoring system to monitor during life cycle of compliance, Safety and RAM targets to be achieved and establishment of a Reliability, Availability, Maintainability and Safety (RAMS) assurance process to ensure that hazards are identified and managed and that the Safety and RAM targets can be shown to be met.
- 14.1.2** The design performance of traction system shall provide very high level of Reliability, Availability, Maintainability and Safety through RAMs analysis, which can be demonstrated through data gathered during operation of the 2 X 25 kV Traction System.

14.1.3 Terms & Definitions and Abbreviations

- (1) In this document, following defined terms shall have the meanings as described here below:

Definitions	Descriptions
Apportionment	process whereby the RAMS elements for a system are sub-divided between the various items which comprise the system to provide individual targets
Assessment	undertaking of an investigation in order to arrive at a judgment, based on evidence, of the suitability of a product
Availability	ability of a product to be in a state to perform a required function under given conditions at a given instant of time or over a given time interval assuming that the required external resources are provided
Compliance	A demonstration that a characteristic or property of a product satisfies the stated requirements.
Corrective Maintenance	maintenance carried out after fault recognition and intended to put a product into a state in which it can perform a required function
Down time	time interval during which a product is in a down state
Failure mode	predicted or observed results of a failure cause on a stated item in relation to the operating conditions at the time of the failure

Definitions	Descriptions
Fault tree analysis	analysis to determine which fault modes of the product, sub-products or external events, or combinations thereof, may result in a stated fault mode of the product, presented in the form of a fault tree
Hazard	physical situation with a potential for human injury and/or damage to environment
Hazard log	Document in which all safety management activities, hazards identified, decisions made and solutions adopted are recorded or referenced. Also known as a "Safety Log"
Maintainability	probability that a given active maintenance action, for an item under given conditions of use can be carried out within a stated time interval when the maintenance is performed under stated conditions and using stated procedures and resources
Preventive maintenance	maintenance carried out at predetermined intervals or according to prescribed criteria and intended to reduce the probability of failure or the degradation of the functioning of an item
Reliability	probability that an item can perform a required function under given conditions for a given time interval
Reliability growth	condition characterized by a progressive improvement of a reliability performance measure of an item with time
Repair	that part of a corrective maintenance in which manual actions are performed on the item
Restoration	that event when the item regains the ability to perform a required function after a fault
Risk	probable rate of occurrence of a hazard causing harm and the degree of severity of the harm
Safety	freedom from unacceptable risk of harm
Safety case	documented demonstration that the product complies with the specified safety requirements
Safety integrity	likelihood of a system satisfactorily performing the required safety functions under all the stated conditions within a stated period of time
Safety integrity level (SIL)	One of a number of defined discrete levels for specifying the safety integrity requirements of the safety functions to be allocated to the safety related systems. Safety Integrity Level with the highest figure has the highest level of safety integrity
Safety-critical	Failure of the system, sub-system or equipment will directly lead to a situation with the potential to cause harm, injury, damage to property, plant or equipment, damage to the environment, or economic loss.

Definitions	Descriptions
Tolerable risk	maximum level of risk of a product that is acceptable to the Railway Authority
Validation	confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use have been fulfilled
Verification	Confirmation by examination and provision of objective evidence that the specified requirements have been fulfilled.

(1) Abbreviations

Abbreviation	Definition
ALARP	As Low as Reasonably Practicable
DT	Down Time
EN	European Norm
FMECA	Fault Mode Effects and Criticality Analysis
FMEA	Fault Mode and Effects Analysis
FTA	Fault Tree Analysis
FRACAS	Fault Report Analysis and Corrective Action System
GS	General Specifications
IHA	Interface Hazard Analysis
ISO	International Organization for Standardization
IEC	International Electro-technical Commission
MCIL	Maintainability Critical Item List
MDT	Mean Down Time
MTBF	Mean Time Between Failures
MTBSAF	Mean Time Between Service Affecting Failure
MTTR	Mean Time to Restore
O&SHA	Operating and Support Hazard Analysis
OPM	Other Preventive Measures
PHA	Preliminary Hazard Analysis
PS	Particular Specifications
RAM	Reliability Availability Maintainability
RAMS	Reliability Availability Maintainability and Safety
RBD	Reliability Block Diagram
RCIL	Reliability Critical Item List
RDT	Reliability Demonstration Testing
RTU	Remote Terminal Unit
SCIL	Safety Critical Items List
SSHA	Subsystem Hazard Analysis

14.1.4 RAMS Principles

- (1) The 2x25kV, ac, Electric Traction system shall be designed to achieve all RAM requirements specified in this PS and EN 50119.
- (2) The design, manufacture, installation and commissioning of the equipment as well as training of the operating and maintenance staff shall be such that to ensure near Zero Failure performance in the initial stages and that the few defects & deficiencies that may be exposed during the Service Trial are totally eliminated.
- (3) All the sub-systems and equipment to be used shall be of proven design with a high degree of reliability and in use in other similar Railway projects. Calculations shall be performed using appropriate design models involving relevant variables. The design values and verification methods shall conform EN:50119.
- (4) The sub-systems and equipment shall be engineered to maximize system availability during traffic hours, to minimize the amount of maintenance required and to ensure that any maintenance can be easily and quickly carried out in minimum time, with minimum skill, and at minimum cost.
- (5) Fault Tolerance & Graceful Degradation: The system shall be designed such that service can be maintained in the presence of Single point faults Scenario. Subsystems and components whose failure can significantly impact on RAM performance shall be backed up by built in redundancy in Sub-systems or components that permit continuous operation.
- (6) Recovery: Provision shall be made to recover from any credible fault while minimizing disruption to service.
- (7) Condition Monitoring & Diagnostics: Diagnostic systems shall be used to detect, or where practicable, monitor the condition of the equipment, anticipate faults, and do need based proactive Predictive maintenance and to reduce requirements for periodic inspection Preventive maintenance, to reduce overall costs, and improve reliability.
- (8) The Contractor shall submit system Reliability, Availability and Maintainability (RAM) Plan for review & approval of Engineer for complete Electric Traction System comprises of Traction Power Supply (TPS), Overhead Contact System (OCS), and Power SCADA.

14.2 RELIABILITY

Reliability Modelling

- (1) The Contractor shall perform Reliability and Maintainability analyses of each system, up to the point of interface with other systems.
- (2) The Contractor shall develop an evolving Reliability model consisting of Reliability Block Diagrams and probability of success equations. This model shall show the relationships required for system and equipment to operate successfully. The reliability block diagrams shall include all elements essential to the successful performance of the system and the interrelationships and interface of these elements. The model shall not reflect the degraded mode of operation. The Contractor shall revise the model to keep current with design iterations.
- (3) The reliability model consisting of reliability block diagrams and probability of success equations shall be developed and submitted to the Employer for

acceptance.

- (4) Reliability apportionment and prediction analysis shall be in accordance with established techniques or standards, or properly documented and verifiable field failure data for identical or similar equipment. The standards used or the source of field data shall be identified.
- (5) The Reliability apportionment and prediction analysis shall be carried out in parallel with the design of the system. The relevant apportionment and prediction figures shall be part of the design submission documents for the individual equipment, sub-system and system.

Failure Definitions

- (1) Failure: The inability to perform a required function, the occurrence of unexpected action by the equipment, or the degradation of performance to below the required specifications shall constitute a failure.
- (2) Relevant Failure: A relevant failure of an item is an independent failure which results in a loss of function of that item caused by any of the following:
 - * A fault in an equipment or sub-system while operating within its design and environmental specification limits;
 - * Improper operation, maintenance, or testing of the item as a result of the Contractor supplied documentation.
 - * Failures of transient nature including those with post investigation status as 'No fault found', shall be considered as relevant failure if in the opinion of the Employer these are attributable to Electric Traction System.
- (3) Non-relevant Failure: Any failure of an item not included in the definition of relevant failure, such as the following:
 - * A failure caused by malfunction of other equipment or sub-system that are not supplied by the Contractor;
 - * A failure caused by human error, except as noted in Relevant Failure above;
 - * A failure caused by accidents not associated with the normal operation of the item;
 - * A failure caused by operating the equipment or sub-system outside of design or environmental specification limits;
- (4) Service Failure: Any relevant failure or combination of relevant failures during revenue service operations to determine availability for revenue service, which results in one of the following:
 - * Delay to train service;
 - * Fault preventing a train from entering service at its scheduled time;
- (5) Pattern Failure: The repeated occurrences of 3 or more relevant failures of the same replaceable part, item or equipment in same manner in identical or equivalent applications when they occur at a rate which is inconsistent with the predicted failure rate of the part, item or equipment will be termed as pattern failure.

Reliability Requirements

- (1) Reliability requirements and goals shall be developed in terms of Mean Time Between Service Failures (MTBSAF).

- (2) The reliability requirement is subsidiary to the Availability and Maintainability requirements as specified in this PS.
- (3) The Electric Traction System shall be fault tolerant such that the loss of functionality under failure conditions is minimized and that the system, where practicable, degrades gracefully and either continues to perform its required duty unaffected by failed elements.
- (4) Redundant equipment/module/component shall change seamlessly when active part fails. If changeover has a finite time, contractor shall show that its system shall not obstruct the train operation.
- (5) The system design shall ensure that the subsystems providing redundancy for failures are truly independent to minimize the risk of common mode faults.
- (6) The Traction Power Supply (TPS) shall be designed such that any single key components may fail without impact on the operational performance of the overall Electric Traction system. This shall be demonstrated by calculation of the load flow in case of outage of critical main components, e.g. main traction transformer.
- (7) All consumable and/or bought-out items shall have a high level of reliability, in particular where they shall remain continuously energized and in service e.g. insulators under tensile or compressive condition..
- (8) The Electric Traction system shall be able to be operated independently from Power SCADA. In event that the SCADA system fails then the traction power and its protection system shall continue to operate autonomously, until either the SCADA system comes on line or until the switching station is placed into local control.
- (9) The Contractor shall select the Equipment & components to achieve the required level of Reliability, Availability and Maintainability with highest MTBSAF matching with Industry benchmarks if any for approval of the Engineer.

Reliability Demonstration

- (1) During the RAM demonstration phase, the Contractor shall collect and maintain data on every failure along with the data indicating the probable failure. MTBF shall be calculated throughout the monitoring period. The Contractor shall submit monthly Reliability Demonstration Reports.
- (2) In case the Contractor is not able to achieve specified/predicted reliability target, the Contractor shall take necessary corrective measures either by way of change of design and/or replacement of the relevant equipment / component, at no additional cost to the Employer.
- (3) The Contractor shall analyse each and every failure/ defect of components of various equipment to determine the cause of failure and propose corrective measures, which would be reviewed by the Employer.
- (4) The high voltage circuit breakers, supply transformers, traction transformers, auxiliary transformers, interrupters, and AC cable (1000 Meters) have to be demonstrated for reliability as planned.

Reliability assessment

A Risk & failure study shall be performed for the various Sub-Systems, identifying the failure modes for each which contributes to reliability of the system and quantitative estimates prepared of the likelihood of failure. The system and the components shall

comply with EN 50126/IEC 62278.

- (1) The Contractor shall demonstrate the reliability of the proposed design and material for OHE equipment within the HORC operating environment of Prithla – New Harsana Kalan section.
- (2) For all critical items of the equipment offered the Contractor shall state the **Mean Time between Failure (MTBF)**, the Mean Time to Restore (MTTR), and details of preventative maintenance required to maintain full operational performance.
- (3) Where equipment has novel features or where insufficient operational data is available, the Contractor shall state the methods used to determine reliability performance.
- (4) All consumable and/or bought-out items shall have a high level of reliability in particular where they shall remain continuously energized and in service e.g. insulators.
- (5) Reliability criteria of Traction Power Supply System shall be as per class in table below

Reliability Class	Description (Service affecting Failure)	Reliability Class Criteria (Failures per annum)
R1	Delay to train services exceeding 12 minutes, or fault preventing a train from entering service at its scheduled time.	35
R2	Delay to train services exceeding 30 minutes	10
R3	Delay to train services exceeding 60 minutes or closure of a crossing station for more than 2 hours, or implementation of single line working for a period of one hour or more.	0.667
R4	Severe service disruption resulting in trains being stranded on track for more than two hours or closure of a crossing station for more than one day	0.333
TOTAL		46

14.3 AVAILABILITY

- (1) The Contractor shall be responsible for providing a System design, maintenance procedures, and defining the recommended spares holdings to ensure that the Availability requirements of the system shall be achieved.
- (2) Availability shall be assessed by the calculated as follows:

Where:

$$\text{Availability} = \frac{MTBSAF}{(MTBSAF + MTTR)} \times 100\%$$

- (i) MTBSAF = Mean Time Between Service Affecting Failures.
 - (ii) MTTR = Mean Time to Restore
-
- (3) The Contractor shall submit calculations with reliability block diagrams for each sub-system till LRU level to demonstrate the compliance with specified availability figures. The availability calculation shall take all possible failure modes into consideration that cause gap in service operation of system, subsystem, equipment or part thereof. The calculation shall be based on the Contractor's submitted equipment MTBSAF and MTTR data and the configuration of each sub-system.
 - (4) The overhead contact system design, arrangement and component design shall be chosen to ensure that the HORC shall have high service availability.
 - (5) The OHE design shall have mechanical independence of support for main line & where practicable for other lines. Adequate clearances shall be considered for designing to eliminate the chances of known short time interruptions due to Bird electrocution/ faults.
 - (6) The arrangement of tension lengths and wire runs shall minimize the effect of overhead equipment damage in a station or crossover on neighboring sections, in the event of overhead contact or catenary wire failure.
 - (7) TSS, SSP, SP, SS and ATS if any, shall be designed to a 100% availability level of N-1(First failure).
 - (8) Circuit breakers are provided to operate on definite fault or over current conditions, and should isolate only the faulty section/ part or equipment of OHE and Power supply system ensuring healthy system is not affected.
 - (9) Error detection and correction mechanism shall be included in the communication links as appropriate depending on the nature and functional criticality of the data conveyed.
 - (10) Switchover between redundant equipment, or between redundant routings, shall occur automatically and immediately upon failure and shall be transparent to the users. Toggling in switchovers shall be prevented.
 - (11) The Over Head Equipment (OHE) design shall have mechanical independence of support for main line & where practicable for other lines.
 - (12) The complete SCADA system shall be designed to meet 99.99% hardware availability. The OCC equipment shall have 100% redundancy. All OCC equipment shall be supplied power from two independent sources of supply.
 - (13) The OHE & ROCS shall have Availability better than 99.5% and Traction Power Supply sub-system better than 99%.
 - (14) Degraded performance or loss of any software or hardware dependent function of any end equipment shall be taken as unavailability.
 - (15) The contractor shall assume in the calculations that the service operating hours are 20 hours per day (00:00 to 10:00) and 14.00hrs to 24.00hrs.for 365 days in a year or as decided by the Engineer.
 - (16) It shall be possible to automatically re-energize the overhead line immediately

following the occurrence of transient faults such as lightning, or bird strike causing a momentary short circuit. The auto-enclosure shall be of one shot only.

- (17) Save and except where specifically approved, failures of the overhead line, or support equipment shall not cause loss of traction supply to more than one line. Provision shall be made, through section isolators/ interrupters/ Circuit breakers and other means, to allow reconfiguration of the traction power supply to feed the overhead line in areas not directly affected by the fault.
- (18) Mechanical joints of conductors, which may be susceptible to failure, shall, where practicable, not be located in close proximity to locations where there is an interface where the public have access. e.g. Adjacent Indian Railways Stations and level crossings. Locations where the public have reasonable access may be inspected by the Engineer prior to Energisation of the electrical section.
- (19) Availability Demonstration
 - i. The Contractor shall demonstrate the specified Availability during Service Trials and during the DNP. The Availability Demonstration Testing (ADT) shall be conducted on all Systems, subsystems and their interfaces.
 - ii. The demonstration test measure for Availability shall consider the performance of the Contractor's installed equipment, and the effectiveness of maintenance procedures recommended by the Contractor.
 - iii. The availability shall be worked out on the basis of the formula given during the preceding six months. In the event that the availability target as specified is not achieved, the Contractor shall,
 - (a) The determination of availability achievement in the preceding six month period shall be continued at monthly intervals until the target is achieved.
 - (b) The contractor at his own expense, will take action deemed necessary to meet the availability requirement.

14.4 MAINTAINABILITY

- (1) Maintainability requirements and goals shall be developed in terms of Mean Time to Restore (MTTR) for all sub systems.
- (2) The MTTR shall include the diagnostic time, active repair / replacement time and adjustment / testing time, including software re-boot, up to the point the system is restored to full functionality. In the event that the failure cannot be rectified, the measurement shall include the time necessary to remove the failed piece of equipment from the System and replace it with a functional module.
- (3) The MTTR does not include the time taken for designated personnel to arrive on site (access time) to begin local diagnostic activities or the time taken for the replacement parts to be delivered at site.
- (4) Quantitative Maintainability assessments to all significant functional levels of the system, subsystems or equipment shall be allocated. Maintainability analyses during engineering, development and testing shall be used to evaluate the degree of achievement of the maintainability requirements. The Contractor shall identify the standards by which these allocations are made.
- (5) The System shall be suitably designed to minimize the need for frequent preventive

maintenance.

- (6) Built-in self-diagnostics, power-up self-test and sufficient test points shall be provided in the System to minimize the time required to locate a fault. In addition, especially the OHE & ROCS System and the associated traction power cable network shall be so arranged that the corrective maintenance work can be easily carried out under accidental crippled operation.
- (7) All components, material, software and supports required for repair and servicing of the System shall be available during the entire lifetime of the System.
- (8) The system shall maximize the use of remote means to conduct maintenance, fault finding and fault rectification activities and to access maintenance information.
- (9) The Contractor shall select the Equipment & components to achieve the required level of Reliability, Availability and Maintainability with least MTTR matching with Industry benchmarks, if any, for approval of the Engineer.
- (10) The Power SCADA shall have an MTTR of less than 30 minutes. The Overhead Contact System shall have an MTTR less than 4 hours.
- (11) The Contractor shall identify and Describe/document the maintenance requirement for the overhead contact equipment.
- (12) The maintenance commitment in terms of frequency, number of personnel and specialist equipment shall be worked out by the contractor.
- (13) OHE maintenance in terms of quantum of work and its frequency, number of personnel, varieties of types and number of specialist items and spares, shall be minimum.
- (14) Repair facilities shall be provided to optimize speedy corrective maintenance by employing automatic diagnostics, test points etc. In addition, especially the OHE System and the associated traction power cable network shall be so arranged that the corrective maintenance work can be easily carried out under accidental crippled operation.
- (15) All OHE components including tensioning devices shall be installed with sufficient lubrication to prevent mechanical failure in service.
- (16) Maintainability Demonstration**
 - i. The Contractor shall carry out tests to demonstrate that all maintainability predictions provided are met.
 - ii. The maintainability demonstration shall consist of simulated failures and repair activities, the duration of which shall be measured to determine the MTTR. As an alternative, data from actual maintenance actions for relevant independent failures occurring during the testing period may be used in lieu of simulation.
 - iii. A minimum of 50 maintenance actions shall be included for this demonstration.
 - iv. The maintenance actions shall be distributed among the equipment of each test group in proportion to their expected failure occurrence and in accordance with the MTBF.
 - v. In the event that any maintainability target is not achieved, the Contractor

shall at his own expense take whatever action is deemed necessary to meet the maintainability targets.

- vi. The Contractor shall ensure that all the required information including the related Maintenance Work Instructions (MWI) etc. is available to enable him to demonstrate the maintainability targets.

14.5 SAFETY

14.5.1 General

- (1) Safety is defined as freedom from those conditions that can cause death, injury, occupational illness, or damage to or loss of equipment or property, or withdraw the train from service, which is considered as a risk in all circumstances susceptible to cause injuries or person death (passengers, operation staff, maintenance staff), and/ or by extension all events leading to a partial or total destruction of costly equipment.
- (2) The contractor shall be fully responsible for the system safety through the application of engineering and management principles, criteria and techniques to optimize all aspects of safety throughout all phases of the System life cycle.
- (3) During consideration of precedence in the control of system hazards, the Contractor shall take account of human limitations as an engineering constraint. The Contractor shall take actions to satisfy requirements in the following order of precedence:
 - (a) Incorporation of fail-safe or vital features which would allow the system to transfer from a high loss or risk mode to a lower loss or risk mode upon the occurrence of a critical failure; and,
 - (b) Reduction of the probability of occurrence of a failure by increased component reliability or by provision of supervised redundant components
- (4) Items relating to safety, contained within this Design Criteria and Standards, do not necessarily cover the full safety requirements.
- (5) The Contractor shall be responsible for addressing all of the issues relating to safety, compliant with Indian Railway safety regulations.
- (6) The design, construction, maintenance and monitoring of safety critical items, must be such as to guarantee safety at a level determined by the Contractor and presented to the Engineer for approval.

14.5.2 Safety Requirements

During each stage in the design and development process, the Contractor shall take cognizance of any hazard that arise as a result of the design or operation of the proposed equipment and take immediate steps to change the design or operation principals of the proposed equipment to mitigate the hazard.

All safety hazards shall be mitigated at the design stage where practicable.

- (1) The installation design shall incorporate measures to avoid presenting safety hazards.
- (2) The Systems design shall incorporate measures to provide for its safe management and operation.
- (3) The Systems shall not give rise, or be subject to, dangerous interactions within the

railway/DFCCIL or with other systems. Particular attention shall be paid by the Contractor to the interface with the adjacent Indian Railways infrastructure.

- (4) The operation and maintenance of equipment inside the TSS, SP, SSP and SS shall satisfy the safety rules and system operation requirements of state power company.
- (5) The system shall have fail-safe features. The Contractor shall incorporate the SCADA earthing design requirements in the earthing and bonding management plan and design as described in this Particular Specification conforming to EN 50122-1.
- (6) The Contractor shall use safety devices to reduce the magnitude of the loss or risk once a hazardous mode has been entered; and ensure that the safety device does not introduce an additional hazard or system malfunction.
- (7) The Contractor shall use warning devices and systems which are audio/visual portion of a vital system in which the human is the responder. The Contractor shall recommend special equipment operating procedures to reduce the probability of a hazardous event. All automatic/ manual switchover between Main and Standby equipment shall be seamless and shall not affect the normal and emergency operation of the system.
- (8) The Traction installation shall meet the fire safety requirements as per Indian Electricity Rule and National Building Code etc.
- (9) The design of the earthing system shall conform to IS 3043: 1987 (including latest amendments) and EN 50122-1, EN 50522, CBIP and IEEE-80:2013 as applicable to different parts of system.

14.5.3 System Safety Plan

- (1) The Contractor shall develop a System Safety Plan as an integral part of the design which shall be reviewed / approved by The Engineer.
- (2) The Plan shall address the general safety aspects associated with the OHE & ROCS design and peripheral features.
- (3) The Plan shall include, Hazard Operability Studies (HAZOP) and Fault Tree Analysis (FTA) which shall fall into the following three categories:
 - (a) Subsystem hazard analysis (SSHA).
 - (b) Interface hazard analysis (IHA).
 - (c) Operating and support hazard analysis (O & SHA).
 - (d) Each of the above shall identify four degrees of risk:
 - (i) Catastrophic.
 - (ii) Critical.
 - (iii) Marginal.
 - (iv) Negligible.
 - (e) The above items related to safety do not necessarily cover the full requirements.
 - (f) It is the Contractor's responsibility to address all aspects of safety and comply

with legislation.

- (g) The contractor should indicate mitigation measures for each hazard to keep the impact as low as reasonably practical (ALARP).

14.5.4 Quantified Risk Assessment

- (1) The Contractor shall prepare a Quantified Risk Assessment (QRA) to model the risk to:
 - (a) public
 - (b) maintenance and operations staff
 - (c) Public and staff on the adjacent Indian Railways Line and other third party infrastructure.
- (2) The QRA shall address the risk of electrocution from the OHE and other equipment. For maintenance personnel key elements of the QRA shall include as a minimum an assessment of the risk of being struck by a train while working line- side, falls during maintenance, electrocution or injury due to crossing into Indian Railways territory. Accidental charging of dead section due to problem with SCADA and or due to other reasons and Interlocking posing safety hazard shall also be addressed.
- (3) The Contractor shall demonstrate that the Systems have been designed to minimize the risk due to operator and maintainer error, considering both the ergonomic aspects of the System design to reduce the likelihood of error, and protective measures are adopted to mitigate the consequence of such error.
- (4) The Contractor shall demonstrate that risk to public, including trespassers is as low as reasonably practicable.
- (5) The contractor should indicate mitigation measures for each hazard to keep the impact as low as reasonably practical (ALARP).

14.5.5 Risks on Functional Safety

- (1) The risks on functional safety System will include, but not be limited to, the following items:-
 - (a) Explosion or fire at TSS, SSP, ATS (if any), SP, SS and SCADA equipment room;
 - (b) Equipment safety;
 - (c) Damage to overhead conductors;
 - (d) Damage to overhead current collection system equipment;
 - (e) Damage to 25kV feeder and return cables;
 - (f) Electrical safety including safety clearance from exposed live conductors;
 - (g) Safety of the Engineer's staff and public, including trespassers as far as is reasonably practicable.
 - (h) Occupational repetitive injuries.
- (2) The Contractor shall minimize the above-mentioned risks to a level as low as reasonably practicable in the design and construction stages of System.
- (3) The contractor should indicate mitigation measures for each hazard to keep the

impact as low as reasonably practical (ALARP).

14.5.6 Minimum Factors of Safety

- (1) The mechanical design of OHE, contact wire, catenary wire, ROCS and other conductors shall take into account the permissible tensile stress, maximum temperature, allowable wear, wind loads, efficiency of tensioning devices, termination fittings, welded or soldered joints, additional vertical load in accordance with EN 50119 to allow adequate factor of safety under all conditions.
- (2) Structures and SPS, in combined tension/compression and bending, shall have safety factors in compliance with the appropriate design codes.

14.5.7 Hazard Log

A Hazard Log shall be established as a basis for on-going risk management. The hazard Log shall be updated with each event identified and mitigated. Residual Risk shall be carried forward and rules and procedures proposed to the Employer for the Management of such Residual Risk.

14.5.8 Hazard Analysis

- (1) The Contractor shall, as part of the safety analysis, prepare analysis to identify Hazards and ensure their satisfactory resolution. The following analysis shall be prepared and submitted by the Contractor for the Employer's acceptance:
 - (a) Preliminary Hazard Analysis (PHA)
 - (b) Subsystem Hazard Analysis (SSHA)
 - (c) Interface Hazard Analysis (IHA)
 - (d) Operating and Support Hazard Analysis (O&SHA)
 - (e) Quantitative Fault Tree Analysis (QFTA)
 - (f) Failure Modes, Effects and Criticality Analysis (FMECA)
- (2) The Contractor shall carryout the Hazard Analysis and FMECA/FTA for key equipment / sub-systems / systems. As a result of hazard analysis, the Contractor shall:
 - (a) Identify and list the hazards
 - (b) Identify and list the Safety Requirement Specifications
 - (c) Identify and list the safety related functions
 - (d) Specify for each safety related function the safety related failures
 - (e) Identify and list the safety critical and non-safety critical items.
- (3) The hazard analysis shall address the risk of electrocution from the OHE, ROCS and otherequipment. For maintenance personnel key elements shall include, as a minimum, an assessment of the risk of being struck by a train while working line-side, falls during maintenance, electrocution or injury due to crossing into Indian Railways territory. Accidental charging of dead section due to problem with SCADA and or due to other reasons and Interlocking posing safety hazard shall also be addressed.
- (4) The functional safety risk analysis translating to category of Hazards will include but not limited to the following:-
 - (a) Explosion or fire at TSS, SP , SSP, ATS (if any), SS, and SCADA

- (b) equipment room;
 - (c) Equipment safety;
 - (d) Damage to overhead conductors;
 - (e) Damage to overhead current collection system equipment;
 - (f) Damage to 25kV feeder and return cables;
 - (g) Electrical safety including safety clearance from exposed live conductors;
 - (h) Safety of the Engineer's staff and public, including trespassers as far as is reasonably practicable.
 - (i) Occupational repetitive injuries.
- (5) The Hazard Review Procedure shall be submitted for the Employer's approval. The final risk assessment, acceptance of mitigation and close out of hazards shall conform to the approved safety and risk acceptance criteria.
- (6) The following targets/norms shall be employed for the Fault Tree Analysis. These norms are subject to review by the Engineer during the detailed design stage, and mutually agreed upon:
- (a) No single point failure shall lead to fatality.
 - (b) No combination of undetected failure and double point failures shall result in fatality.
 - (c) No combination of undetected failure and single point failure shall result in major injury.
- (7) The Hazard Log shall be substantially complete prior to commencement of Trial Running and shall be handed over to the Engineer complete in all respects prior to the commencement of Revenue Service.
- (8) The Contractor shall fully develop a Safety Critical Items List (SCIL) which shall be updated as required and carried forward throughout implementation until final resolution of identified hazards is achieved.
- (9) The design, construction, maintenance and monitoring of safety critical items, must be such as to guarantee safety at a level determined by the Contractor and presented to the Engineer for approval.
- (10) Further, the information presented by the Contractor shall be supported by the history of tests conducted and by approved test certificates from accredited laboratories which attest to the engineering program characteristics and behaviour.
- (11) The procedures for Operation, Maintenance, Training and the Contractor Quality Assurance manuals shall incorporate resolution of hazards so identified from this Hazard Analysis. Proper cross-referencing to the hazards and resolution measures shall be provided in all these aforementioned documents.

14.5.9 Design/Systems Safety Studies and Report

The Design/Systems Safety Studies and a Report shall be submitted at the completion of the Detailed Design period to confirm that all safety related aspects of design have been properly addressed and comprehensively validated.

14.5.10 Engineering Safety Validation Plan and Report

- (1) The Contractor shall submit Engineering Safety Validation Plan to demonstrate that

the system has been designed to minimize the risk due to a hazard and protective measures have been adopted to mitigate the risk.

- (2) The Engineering Safety Validation Plan will outline the safety related tests to be conducted during the on-site testing and integrated system testing phase. The document will include the validation of the safety requirements for the system. Throughout this document details test cases carried out in order to validate the system, the relationship of the effects found in these tests and the validation of the same in subsequent tests will ensure that the system comply with the safety requirements.
- (3) The Contractor shall demonstrate that the sub-systems have been designed to minimize the risk due to operator and maintainer error, considering both the ergonomic aspects of the System design to reduce the likelihood of error, and protective measures are adopted to mitigate the consequence of such error.
- (4) An Engineering Safety Validation Report will be submitted after the completion of this testing.

14.5.11 Relational Database Management System

- (1) All hazard resolution by procedural control shall be cross-referenced from the safety critical and non-safety critical Items List to the appropriate manuals. The results of the Hazard Analysis shall be recorded and maintained by the Contractor in a Hazard Log in the form of a relational database that can be used to track progress in the implementation of mitigating actions and control measures, and provide an easily accessible reference for the future Operator of all actions taken with respect to any hazard of any type in an any location for any area of activity. Proper cross-referencing to the hazards and resolution measures shall be provided in all these afore mentioned documents.
- (2) The fully functional soft copy of the relational database management system shall include together with all passwords, supporting software and instructions on its use and further development during Revenue Service.

14.5.12 RAM Demonstration

(1) RAM Demonstration Plan

- i. The Contractor shall submit RAM Demonstration Plan to the Engineer for approval before the final design review to demonstrate that all RAM predictions and specifications are met.
- ii. The requirements relating to Maintainability shall be demonstrated before the commencement of Trial Running and may begin as soon as the necessary systems or elements of systems have been tested and commissioned.
- iii. The requirements relating to Reliability and Availability shall be demonstrated throughout Trial Running Period and the Defects LiabilityPeriod.

(2) Failure Reporting and Corrective Action System (FRACAS)

- i. The Contractor shall be required to establish a computer based Failure Reporting and Corrective Action System (FRACAS) during the RAM Demonstration phase. The FRACAS proposed by the contractor shall need the approval of the Employer.
- ii. The FRACAS will:
 - (a) Provide a process for reporting, classifying, analyzing failures, and planning corrective actions in response to those failures.

- (b) Collect data, record and analyse system failures.
- (c) Produce a history of failure and corrective actions.

14.5.13 System Assurance Submissions

Deliverable Documents

The Contractor shall implement and submit system assurance supporting documents in accordance with the approved System Assurance Plan which shall include, but not be limited to, the following documents at the times indicated in the table below:

S No	Document Description	Plan Development Stage					Remarks
		Design Stage		Manufac ture/C onstruc tion/Inst allation	Testing/ Trial Run Stage	Warranty Stage	
		PRELIM	FINAL				
1	System Assurance Plan (included System RAM Plan and System Safety Plan)	P					Shall be submitted within 56 days after the Commencement Date
2	System RAM Plan		U	U	U		
3	System Safety Plan		U	U	U		
4	Safety Policy	P					Shall be submitted within 56 days after the Commencement Date
5	Hazard Analysis and Hazard Log	P	U	U	U	U	First report shall be submitted within 28 days after the preliminary design completion. The report to include Safety Requirements Specifications and Safety Critical Item List (SCIL).

**Part 2, Section VII-2 : Employer's Requirements - Particular Specifications (PS)-for 2x25 kV, AC
Traction electrification and associated works**

6	Design/ Safety Studies and Report		P	U	U		First report shall be submitted within 28 days after the final design completion. The report shall at least include the Safety Requirement
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S No	Document Description	Plan Development Stage					Remarks
		Design Stage		Manuf acture/C onstruc tion/Inst allation	Testing/ Trial Run Stage	Warranty Stage	
		PRELIM	FINAL				
							Specification, Hazard Log, Deterministic Safety Assessment, Quantitative Risk Assessment, Safety Integrity Level Analysis, Failure Mode, Effect and Criticality Analysis, Reliability Block Diagram
7	RAM Analysis and Prediction Report		P	U	U	U	First report shall be submitted within 28 days after the final design completion. Report will also include RCIL and MCIL.
8	FMECA		P	U	U	U	First report shall be submitted within 28 days after the final design completion
9	RAM Test / Demonstration Plan		P	U	U	U	First report shall be submitted within 28 days after the final design completion. The demonstration plan shall include the proposed FRACAS system.

**Part 2, Section VII-2 : Employer's Requirements - Particular Specifications (PS)-for 2x25 kV, AC
Traction electrification and associated works**

10	RAM Test / Demonstration Report				P	P	- Reports shall be submitted separately within 28 days after each completion of demonstration tests in terms of maintainability demonstration test, and availability / reliability demonstration test. - Monthly RAM - Demonstration Records and Reports shall be submitted at the 7 th day for prior month ending during Defect Notification Period
11	Engineering Safety Validation Plan		P	U	U		First report shall be submitted within 28 days after the final design completion
12	Engineering Safety Validation Report				P		Shall be submitted within 28 days after completion of safety validation test
13	Operational Safety Case	P			P		Second report shall be submitted within 28 days after the completion of safety validation test

P - Document Produce

U - Document Update

(End of Chapter 14)

CHAPTER 15 - SUPERVISION AND PLANNING OF MAINTENANCE

15.1 GENERAL

The requirements of supervision and planning of maintenance are to be complied as per Employer's Requirements, Part 2, Section VII-1, Chapter 14: Operation & Maintenance Spares, and Tools & Plants of General Specifications and as per specifications / provisions mentioned below:

15.2 SUPERVISORY STAFF

The Contractor shall provide Competent supervisory & maintenance staff in adequate numbers, having expertise in fault finding, maintenance & repair of the various systems supplied under the Contract for full time appropriately positioned to report at point of assembly/ depot, during any fault to attend during entire Defect notification period, as extended if any, covering at least the following areas of excellence:-

- (1) Traction Substation including SSP, SP and ATS if any
- (2) 2x25kV/1x25kV flexible OHE & ROCS system
- (3) SCADA System

15.3 CONTRACTOR'S OFFICE DURING DEFECT NOTIFICATION PERIOD

Contractor shall establish and maintain the 'Maintenance office(s)' manned with the supervisory and maintenance staff with a Dedicated Desk Officer to attend the calls of the Employer's Personnel and inform their Head of Maintenance who would promptly act to attend the emergencies/ maintenance calls including organizing of all the resources i.e. artisans and Material.

The Contractor Shall Maintain a computer based FRACAS system to log all the events of Failure.

15.4 MAN & MATERIAL REQUIRED DURING DEFECT NOTIFICATION PERIOD

The contractor shall resource the required staff and Material during the Defect Notification period at their own cost 24 hrs all 7 days of every week to attend the Defects. The deployment of staff shall be approved by the Engineer. The Material, if any, used from the spares shall be made good. The contractor shall arrange all the Tools & Plants needed to attend the defects during the Defect Notification period.

The Contractor shall replace, the defective systems/sub-systems/ equipment /modules/items/parts during the Defect Notification Period (DNP). For this purpose, the Contractor shall store adequate number of equipment/modules/items/parts so that the defect is rectified in the least possible time without adversely affecting the train operation.

(End of Chapter 15)

CHAPTER 16 – TRAINING

16.1 GENERAL REQUIREMENTS

The Contractor shall provide comprehensive training to the Employer's personnel in accordance with the requirements contained in this PS and as per Employer's Requirements, Part 2, Section VII-1 Chapter 13 — Training & Transfer of Technology of General Specifications and as per specifications / provisions mentioned below:

16.2 TRAINING PLAN

The training plans shall be developed as per provisions in the General Specifications and submitted to Engineer for review and approval. The plan shall also include but not limited to the following:

- 16.2.1 The training shall be carried out at such locations where the greatest benefit for trainees may be gained .The training will include the Training/ exposure at OEM's Manufacturing Place to give the exposure / hands on experience to the technology, manufacturing process, assembly and quality & Test Checkpoints and sensitise the trainee on the quality and test procedures so that similar standards can be replicated at Place of Maintenance.
- 16.2.2 The Training Plan shall include training at site office/site as above and shall include 200 man-days as a minimum at OEM's Place. The plan shall also include visit to different places, work- areas plants. The cost of travel and stay shall be borne by the Employer. The training should also include 200 instructor man-days as minimum to impart training at work site.
- 16.2.3 The training plan should include subjects like Condition Based maintenance to reduce the down time of equipment/ system and maintenance cost. The plan should also cover the details of equipment/ instruments required for monitoring the condition / health of the equipment / system.

16.3 MOCK UP FOR TRAINING

- 16.3.1 The Contractor shall install mock up equipment for system and any such facility(s) considered necessary for the training of Employer's personnel.
- 16.3.2 The training mock up shall include but not limited to the following: -
 - (1) OHE & ROCS system components
 - (2) Contact, messenger/catenary, negative feeder wire and aerial earth wires;
 - (3) Section insulator;
 - (4) Jumper and cable connections to OHE;
 - (5) Rail bonds and cable rail connections of return circuits;
 - (6) Circuit breakers and Interrupters and their component assemblies;
 - (7) Isolators;
 - (8) SCADA training Aids such as RTU, PCU and OCC.
 - (9) Cut Sections of Circuit breakers, interrupters, cables
 - (10) Cut sections of Gas Insulated switchgear

- (11) Clear photographs of various equipment such as transformers, their windings, rectifier and inverter sets;
- (12) Samples of various clamps and fittings used;
- (13) Control panel, protection schemes, earthing and bonding arrangement;

16.4 TRAINING OF EMPLOYER'S TRAINING INSTRUCTORS (ETI)

16.4.1 The Contractor shall provide training to the Employer's Training Instructors on the various Systems. Aspects covered shall include, but not be limited to, the following:

- (1) Configuration of the entire System, including interface with Indian Railway linking OHE system and boundary location SCADA control;
- (2) Feature and functional principles of the entire System;
- (3) System design aspects including but not limited to design standards, design criteria and parameters, short-circuit and other calculations, Insulation and protection co-ordination;
- (4) Details of major equipment and material including but not limited to 220/132 kV, 25kV, circuit breakers, interrupters, isolators, voltage and current transformers, OHE/ROCS conductors, fittings, assemblies and protection relays, batteries and chargers, and cables of different types and their joints used in the System;
- (5) System operation and maintenance management and procedures;
- (6) SCADA System; and
- (7) Earthing and bonding arrangement, covering safety aspects of touch and step potential safety to personnel, passengers and outsiders.

16.5 OPERATIONS STAFF TRAINING

16.5.1 The objective of the training is to enable the Employer's operations staff to be familiar with the Systems, with focus on the operational aspects under normal and emergency conditions.

16.5.2 The training shall also enable the trainee to acquire full capability for identification, trouble shooting and rectification of faults in the specified duration. After classroom training which includes mock-up of equipment, the staff shall be trained in actual operation.

16.6 COMPUTER BASED TRAINING (CBT)

16.6.1 The Contractor shall submit, for the Engineer's review, the following CBT information documents:

- (1) Operation of the TSS, SSP and SP power Systems;
- (2) Maintenance of TSS, SSP and SP power Systems;
- (3) Operation of OHE including return feeder System;
- (4) Maintenance of OHE & ROCS including return feeder System.
- (5) Operation of SCADA System;
- (6) Maintenance of SCADA System.
- (7) Boundary post SCADA operation by HORC/IR/DFCCIL.

- 16.6.2 The CBT Information Document on Operation of individual System shall contain, but not be limited to, the following:
- (1) General introduction of the System, its functionalities and objectives (including the RAMS requirement);
 - (2) Single line diagrams;
 - (3) Description of the System operation principles, for both normal and emergency operation conditions;
 - (4) An overview on the System configuration, including interface with other agencies;
 - (5) General description of the functions of each key equipment and components of the System with photographs showing the appearance of each of them, where they (Key equipment and components) are located throughout the HORC;
 - (6) List of potential hazards that may arise in operating the System;
 - (7) Any specific points to note in operating the System to ensure safety to personnel (the Employer's staff and members of the public) and equipment, and;
 - (8) Electric shock treatment.
- 16.6.3 The CBT Information Document on Maintenance of individual System shall contain, but not be limited to, the following:
- (1) General description of the functions of key components of the System, with photographs showing the appearance of each of them;
 - (2) A general description of the proposed maintenance strategy of the System and major components;
 - (3) The maintenance plan and procedures proposed for the System and major components in accordance with the MMS;
 - (4) CBT as per the levels of maintenance activities required for the System and major components.
 - (5) An introduction to the special tools and equipment required for maintaining the System and major components;
 - (6) Tests to be conducted after maintenance and the test equipment required.
 - (7) A description of the symptoms of the common faults found on the System;
 - (8) Simulation of faults on the entire System, and how to promptly restore the system; and
 - (9) Other points to be noted in effectively maintaining the System.

16.7 TRAINING AND TRANSFER OF SKILLS

- 16.7.1 The training shall broadly cover the following aspects:
- (1) Flexible OHE & ROCS;
 - (2) SCADA System;
 - (3) Protection and Control;
 - (4) Gas Insulated Switchgear, if used
 - (5) Traction Power Supply equipment.

16.7.2 After training the personnel should achieve satisfactory skills and capabilities as under but

not limited to:

- (1) Identification of various cards and components of RTU
- (2) Erection, wiring and commissioning of RTUs and troubleshooting of RTUs
- (3) Configuration of addresses of RTUs, future expansion and setting up of additional tele-commands, tele-signals.
- (4) Using the test instruments to check the communication cable performance parameters
- (5) Operation & maintenance instructions recommended by OEMs of different SCADA subsystems.
- (6) Skills in special aspects of repair and maintenance of Traction Transformers and Auto- transformers.
- (7) Skills in special aspects of repair and maintenance of installed equipment of 220/132kV, 2x25kV and 25 kV switchgear etc.

16.7.3 Methods of Training shall include Class room training, audio visual aids, mock up, samples, site visits to OEM's Place, and/or places of Installation where such equipment and components are used by any other client of the vendor/ Manufacturer.

(End of Chapter 16)

CHAPTER 17 - OPERATION AND MAINTENANCE DOCUMENTATION

17.1 GENERAL

- 17.1.1 The Contractor shall provide Operation and Maintenance documentation as per Employer's Requirements, Part 2, Section VI, Vol-1, Chapter 14 — Operation & Maintenance, Spares , Tools & Plants of General Specifications.
- 17.1.2 Operation and Maintenance & other Manuals for Installed system to provide all necessary information on traction power supply, all equipment from 220/132 kV TSS incomer/traction substations, through 25kV AT Feeding System and Over Head contact line Equipment (OHE) system, complete with a central supervisory control and data acquisition system (SCADA) for Monitoring & Control of Pirthla – New Harsana Kalan section of HORC but not limited to:
- (i) System configuration/ scheme and major subsystems & components,
 - (ii) System Architecture and Redundancies,
 - (iii) Contingency Scenarios and Mitigation Measures,
 - (iv) Performance Parameters for stringent application duty scenario,
 - (v) Monitoring, Control and Protection system,
 - (vi) Environmental and Operational Parameters for the Electric Traction system,
 - (vii) Reliability, Availability, Maintainability and Safety benchmark, Performance Parameters benchmarks including compliance and demonstrations at design and operational stage,
 - (viii) Design & Drawings,
 - (ix) Producing Combined Service Drawings (CSD) and Interface with the high voltage network of the Indian Railway , and with the associate sub-systems such as rolling stock, train control system, signalling, communications, operations and maintenance requirements, track form, track alignment, depot and station layouts and civil infrastructure,
 - (x) Site execution requirements including Safety, Health, environment Construction Machinery and Methods; Gadgets, Wiring Trains and Inspection Cars and Testing & Commissioning,
 - (xi) Procedures and Statutory Approvals.

(End of Chapter 17

CHAPTER 18 - INTERFACE MANAGEMENT

18.1 GENERAL

- 18.1.1** This chapter outlines the Contractor's interface requirements between Contractors (SYS-1), other designated Civil Contractor (C-5, C-4, C-23, C-1, C-6, T-1, T-2, BR-1), termed as CST Contractors; Signalling and Telecommunication Contractor SYS-2 and Electrical (OHE) Contractor MSIL(OHE), Indian Railways, DFCCIL, State Electricity Authorities and State regulation authorities etc. The details of all Contractors i.e Civil, S&T and Electrical are given in clause 2.3 of PS.
- 18.1.2** The Contractor shall maintain a close interface with relevant authorities, Contractors and agencies to ensure the time bound completion of this project and to ensure that all requirements of the General Specifications and Particular Specification pertaining to interface are fully resolved and implemented.
- 18.1.3** The Interface as described in this document is for reference only. It is the Contractor's responsibility to develop, update and execute jointly an "Interface Management Plan" for defining responsibilities and to exchange information in order to achieve/comply the interface requirements before the commencement of the Work and throughout the execution of the Project work to ensure that:
- (1) All interface issues between the Contractors are satisfactorily resolved;
 - (2) Supply, installation testing & commissioning, operation and maintenance of equipment are fully coordinated; and
 - (3) All equipment and facilities supplied under the Contracts are fully compatible and integrated with each other, whilst meeting the requirements of the respective Specifications.

18.2 OBJECTIVE

- 18.2.1** The design and construction of new HORC lines is a complex multi- disciplinary project, requiring close interaction and co-ordination between the various Contractors.
- 18.2.2** An 'Interface Matrix' is developed to define the interface requirements and demarcate the jurisdiction. The objective of the "Interface Matrix" is to identify the activities of scope of work to avoid conflict amongst different contractors, which could possibly minimise and facilitate hassle free execution of works.
- 18.2.3** This document outlines the interfacing requirement during the execution of the works. However, the requirements herein specified are by no means exhaustive and it remains Contractors' responsibilities to develop and execute jointly an interface management plan throughout the execution of works to ensure that:
- a. All interface issues between 2x25kV, AC Traction Electrification, E&M and Civil Works Contractors (C-5, C-4, C-23, C-1, C-6, T-1, T-2, BR-1), Signalling and Telecommunication Contractor SYS-2 and Electrical (OHE) Contractor MSIL(OHE) and Other Designated Contractors are satisfactorily identified and resolved.
 - b. All the Construction tolerances at the interface shall meet the requirements of the respective specification,
- 18.2.4** This "Interface Matrix" shall be read in conjunction with the relevant provisions of the Contract Specifications. The 'Contractor (SYS-1) and the other Interfacing Contractors

shall be responsible for compliance of all requirement of the Specification in terms of the defined scope of work of the Parties.

- 18.2.5** Notwithstanding the requirements described elsewhere in the contract regarding the precedence of document, the provision contained in the drawings and elsewhere in the particular specifications shall prevail over the provisions contained in this Interface Matrix.
- 18.2.6** Interface requirement for access to works for provision of Traction power supply and 2x25 kV, AC OHE works involving space for traction structures along the tracks, on bridges / viaducts for OHE, Location of signals, as well as of switching off locomotives at neutral sections and finally system proving tests etc shall be resolved.
- 18.2.7** The Employer/Engineer shall organize coordination meetings to resolve all interfacing issues amongst the Contractors. In addition, the system wise Contractor may also arrange his own coordination meetings with the Other Contractors.

18.3 INTERFACING REQUIREMENTS

18.3.1 The following is an indicative list of the Contractors with whom the Contractor (SYS-1) shall essentially interface. The List is not, however, exhaustive and the System Works Contractor (SYS-1) shall ensure that any site problem, as and when it arises, is clearly and conclusively discussed with the appropriate Agency and solutions arrived at.

- 1) Civil, Building, tunnel and Track Work Contractors;
- 2) Contractors of adjacent section i.e IR and DFCCIL, if any.

18.3.2 In addition, the Contractor (SYS-1) is also required to interface with the,

- 1) Indian Railways (Northern Railway)
- 2) Power Supply Authorities: Indian Railway and State Power Supply Authorities / Distribution Companies,
- 3) Statutory bodies like local civil authorities, public utility companies, and
- 4) Those who are considered to be related with the work.

18.4 INTERFACE

18.4.1 INTERFACE WITH CIVIL, BUILDING, TUNNEL & TRACK CONTRACTORS

1) ITEMS OF INTERFACE

The System Works Contractor (SYS-1) shall be responsible for the design, procurement, delivery at site, installation, testing, commissioning, support, operation and maintenance, and setting to work for Overhead Electric Traction System and related wayside switching station equipment and facilities.

Interfacing with Civil, Structure, Tunnel and Track contractors will be required for -

- a) Information regarding track alignment, cant, versine, track geometry, rail levels, gradient, curve details, track center along with transition curve details.
- b) Access to site on main line, traction substations (TSS), switching stations (SSP/SP), Auto Transformers, Isolators, Interrupters etc.
- c) Path, access road to site.
- d) The System Contractor may please note that no movement of men and

material will be permitted on the embankment unless and until the blanket layer upto the designed thickness is finished.

- e) Access & ROW of Rail Track to facilitate movement of Material train and Tower Wagon to finish Wiring & adjustments of the conductors.
- f) Earthing & Bonding connections between AEW, Masts, Rails, all non-current carrying structures including BEC (if required) as per the Schematic attached.
- g) Providing earth continuity in reinforcement bars of girder /concrete bridge and earth terminals at either ends on end sections.
- h) Providing HDPE/ GI pipes below tracks of requisite size for track-crossing by traction cables.
- i) Providing continuity bonds in track, particularly at points and crossings.

2) Information Exchange

The System contractor (SYS-1) shall exchange all the information with the Civil contractors regarding the information on the Traction Power Return System (TPRS) and the Traction Power Distribution System (TPDS) i.e. OHE/ROCS and its supports and the sequence of the execution. The Details shared shall be read in conjunction with the Technical Specifications shared by the Contractor (SYS-1).

3) Interface requirements

The Interface requirements are described in Table-18.4.1

**Part 2, Section VII-2: Employer's Requirements - Particular Specifications (PS)-for 2x25 kV, AC
Traction electrification and associated works**

Table-18.4.1 (a)

**Interfacing Requirement with Civil and Track
Contractors**

Item No.	Item Description	System Contractor (SYS-1)	Civil and Track Contractors (C-5, C-4, C-23, C-1, C-6, BR-1, T-1 and T-2)
1.	<p>Information exchange on alignment with following details:</p> <ul style="list-style-type: none"> a) Formation Cross section b) Track alignment Drawing c) Coordinates of track Centre d) Curves e) gradient f) Rail levels, g) Yard layouts 	<p>Based on the information received from Civil and Track Contractors:</p> <ul style="list-style-type: none"> (i) SYS-1 Contractor shall carry out detailed survey and verify the alignment drawings, Centre line, cross sections, track geometry at mainline and station yards and advise the Civil and Track Contractors regarding infringements and modifications required, if any: (ii) SYS-1 Contractor shall develop Traction System Design & drawings based on the data shared by Civil and Track contractors. (iii) SYS-1 Contractor shall prepare General Arrangement Drawing (GAD) and layout plans for traction supply installations and OHE/ROCS of main line, connectivity lines, station yards and siding including finalization of the Foundation Design & Drawings. 	<ul style="list-style-type: none"> (i) Civil and Track Contractors shall provide final Track alignment drawings & plans, details of track geometry /structure, curves, gradients and Rail levels etc. alongwith details for the main line, connectivity lines, station yards and siding and tunnel data. (ii) Civil and Track Contractors shall share with SYS-1 Contractor, the coordinates of Centre lines of tracks as finalized and approved by the Engineer to facilitate the OHE & Foundation design and drawing by the Contractor (SYS-1).

**Part 2, Section VII-2: Employer's Requirements - Particular Specifications (PS)-for 2x25 kV, AC
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Item No.	Item Description	System Contractor (SYS-1)	Civil and Track Contractors (C-5, C-4, C-23, C-1, C-6, BR-1, T-1 and T-2)
2.	<p>(i) Handing over of formation by Civil Contractors to SYS-1 Contractor for casting of foundations and erection of masts</p> <p>(ii) Handing over of track fit for movement of tower wagon/ wiring train by Track Contractors to SYS-1 Contractor for erection of masts/ portals and wiring works</p> <p>(iii) Final aligning and levelling of track by Track Contractors for SYS-1 Contractor to carry out final OHE adjustments</p>	<p>(i) SYS-1 Contractor shall take the access to the formation received from Civil and Track Contractors and complete OHE foundation & Mast erection work within 30 days. There after shall complete SPS erection, Cantilever, AEW, NFW, Earthing work etc. in co-ordination with Civil and Track Contractor in shared access.</p> <p>(ii) SYS-1 Contractor shall co-ordinate with Track Contractors for linking of track fit for movement of tower wagon/ wiring train and shall undertake OHE wiring work etc. in shared access with Civil/Track Contractors.</p> <p>(iii) SYS-1 Contractor shall coordinate with Track Contractors for final aligning and levelling of track for SED checking in shared access with Civil/Track Contractors.</p>	<p>(i) Civil Contractors shall share the handing over schedule with SYS- 1 Contractor and hand over formation to SYS- 1 Contractor as per schedule</p> <p>(ii) Track Contractors shall share the handing over schedule of track fit for movement of tower wagon/ wiring train with SYS-1 Contractor and hand over track to SYS-1 Contractor as per schedule</p> <p>(iii) Track Contractors shall complete final aligning and levelling of track and shall handover the track to SYS-1 Contractor for undertaking final OHE adjustments.</p>
3.	OHE masts and anchor locations for viaduct	<p>(i) SYS-1 Contractor shall furnish design data of OHE mast to facilitate Civil Contractor for provision of foundation bolts and anchor bolts.</p> <p>(ii) SYS-1 Contractor shall furnish OHE Layout Plan to C-5 Contractor.</p> <p>(iii) SYS-1 Contractor shall coordinate with C-5 Contractor during fixing of bolts.</p>	<p>(i) C-5 Contractor shall share the relevant drawings of viaduct with SYS-1 Contractor</p> <p>(ii) C-5 Contractor shall provide foundation bolts and anchor bolts as per design given by SYS-1 Contractor and also provide template for keeping bolts in position during concreting.</p>

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Item No.	Item Description	System Contractor (SYS-1)	Civil and Track Contractors (C-5, C-4, C-23, C-1, C-6, BR-1, T-1 and T-2)
4.	Provision of support brackets and anchors for ROCS in tunnels.	<ul style="list-style-type: none"> (i) SYS-1 Contractor shall provide support brackets and anchors for ROCS in tunnels. (ii) SYS-1 Contractor shall coordinate with Civil Contractor for any other requirements in tunnels. (iii) SYS-1 Contractor shall coordinate with C-4 Contractor for provision of earthing arrangement. 	<ul style="list-style-type: none"> (i) C-4 Contractor shall share the tunnel data with SYS-1 Contractor for providing support brackets and anchors for ROCS in tunnels. (ii) C-4 Contractor shall provide access to SYS-1 Contractor in tunnels for carrying out ROCS works
5.	Provision of GI pipes below tracks for crossing of power cables across tracks at locations near substations, SP, SSP, switching stations and yards	SYS-1 Contractor shall provide GI Pipe for cable crossings across tracks	Civil and Track Contractors shall facilitate SYS-1 Contractor for laying of GI pipes below track as per requirement.
6.	Provision of Buried Earth Conductor (BEC) if required, and Earthing & Bonding connections Longitudinal to the Alignment, Connections & terminals including crossing under the tracks	SYS-1 Contractor shall provide BEC as per approved drawings.	Civil/Track Contractor shall facilitate SYS-1 Contractor.
7.	Earthing of metallic structure inparallelism with OHE	SYS-1 Contractor shall Provide earthing & bonding of all metallic structures in parallel with OHE by means of two separate and distinct connections with BEC (if required).	Track Contractors shall provide drawings of fencing and other metallic structures running along the track.

**Part 2, Section VII-2: Employer's Requirements - Particular Specifications (PS)-for 2x25 kV, AC
Traction electrification and associated works**

Item No.	Item Description	System Contractor (SYS-1)	Civil and Track Contractors (C-5, C-4, C-23, C-1, C-6, BR-1, T-1 and T-2)
8.	Bridges (Concrete / Steel) - OHE Load on the Pier cap of bridges due to OHE Masts	<ul style="list-style-type: none"> (i) SYS-1 Contractor shall provide OHE Layout Plan (LOP) of proposed locations of OHE Masts. (ii) SYS-1 shall coordinate with Civil contractor and confirm for suitability and extend all assistance for providing Holding Down Bolts (HDB) as per approved design/drawings. (iii) SYS-1 shall also share values of Max direct load, Bending Moment, etc. arising due to the OHE Masts, fittings and anchors, which have to be considered in the design of Piers. (iv) SYS-1 Contractor shall provide staff to witness the provisions made by the Civil contractor for adequacy and suitability. (v) SYS-1 Contractor shall amend the design & install the OHE system appropriately as per the provisions available on the bridges finally executed. 	<ul style="list-style-type: none"> (i) Civil Contractors shall share the relevant drawings of bridges with SYS-1 Contractor (ii) Civil Contractors shall take into account the OHE mast location, loads and bending moment etc. and ensure that the Pier Caps are designed and constructed for OHE Mast. (iii) Civil Contractors shall provide foundation bolts as per design given by SYS-1 Contractor and also provide template for keeping bolts in position during concreting.

**Part 2, Section VII-2: Employer's Requirements - Particular Specifications (PS)-for 2x25 kV, AC
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Item No.	Item Description	System Contractor (SYS-1)	Civil and Track Contractors (C-5, C-4, C-23, C-1, C-6, BR-1, T-1 and T-2)
9.	Electrical Clearances at Bridges(FOB, ROB) Over Head Structures above tracks or OHE	(i) SYS-1 Contractor shall interface for infringements to IRSOD if any and Electrical Clearances and required modifications / improvements. (ii) SYS-1 Contractor shall update /modify traction OHE drawings based on the interface information. (iii) SYS-1 Contractor shall interface and get all drawings & schemes approved from the Engineer ascertaining adequacy of electrical clearances.	(i) Civil Contractors shall supply list of Over Head Structures (FOB & ROB) indicating specific locations, cross-sections, height above rail level and dimensions details for evaluation of infringements, if any. (ii) Civil Contractors shall accommodate the requirement of the SYS-1 Contractor as approved by the Engineer.
10.	Earthing and bonding of Over Head Structure -Steel Bridges – (including FOB, ROB)	(i) SYS-1 Contractor shall provide schematic drawings for Earthing & Bonding of steel bridges. (ii) SYS-1 Contractor shall provide earthing of Over Head steel structures.	Civil Contractors shall facilitate SYS-1 Contractor for earthing and bonding of Over Head structures.

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Item No.	Item Description	System Contractor (SYS-1)	Civil and Track Contractors (C-5, C-4, C-23, C-1, C-6, BR-1, T-1 and T-2)
11.	Earthing & Bonding of concrete bridges /Viaduct.	<ul style="list-style-type: none"> (i) SYS-1 Contractor shall provide schematic drawings for earthing & bonding connections with dedicated reinforcement bars in concrete of Piers cap to Piles/legs of concrete bridges. (ii) SYS-1 Contractor shall interface and get all drawings & schemes approved from the Engineer. (iii) SYS-1 Contractor shall supply and install flexible cable / jumper and connect the terminal plates with BEC (if required) at every consecutive spans. (iv) SYS-1 Contractor shall arrange adequate supervision of appropriate level and at various stages of construction to ensure the provisions of earth continuity in the concrete structures. 	<ul style="list-style-type: none"> (i) Civil Contractors shall install dedicated reinforcement earth bars in concrete to ensure earth continuity as per approved schemes. (ii) Civil Contractors shall allow witnessing by the Contractor (SYS-1) of casting to ensure the continuity of the Earth conductor as per the schemes. (iii) Civil Contractors shall paint marker on the designated earth bar to facilitate the supervision. (iv) Civil Contractors shall supply and install brought-out connections. Viz. Terminal Plates on every Pier Cap and on consecutive span of Viaduct to ensuring earthing & bonding connection with BEC (if required).

Table-18.4.1 (b)

Interfacing Requirement with Signaling & Telecommunication Contractor (SYS-2)

Item No.	Item Description	System Contractor (SYS-1)	signaling & Telecommunication Contractor (SYS-2)
1	Rail continuity bond/impedance bonds, cross bonds	SYS-1 Contractor shall provide Rail continuity bond/impedance bonds, cross bonds as required.	SYS-2 Contractor shall provide the SIP (signaling Interlocking Plan) and location of Rail continuity bond/impedance bonds, cross bonds etc. as required
2	OHE mast/structure Locations and Neutral Section (PTFE) locations	SYS-1 Contractor shall provide OHE mast/structure locations and Neutral section (PTFE) locations	SYS-2 Contractor shall provide the SIP (signaling Interlocking Plan) and location of signals so that there is no infringement to signal, OHE and Neutral section.
3	SCADA system in OCC, TSS, SSP, SP, station building and General Electric supply sub-stations (33/11 kV/440V)	SYS-1 Contractor shall provide SCADA RTU at OCC, TSS, SSP, SP, station building and General Electric supply sub-stations (33/11 kV/440V)	SYS-2 Contractor shall provide the Telecommunication connectivity (by OFC) at RTU location and Ethernet LAN SIP at OCC, TSS, SSP, SP, station building and General Electric supply sub-stations (33/11 kV/440V).
4	Access control System and Intruder alarm in TSS, SSP, SP.	SYS-1 Contractor shall provide Access control System and Intruder alarm in TSS, SSP, SP in RTU and status to be shown in OCC. Shall Coordinate with Contractor (SYS-2)	SYS-2 Contractor shall provide communication system for Access control System and Intruder alarm in TSS, SSP and SP.

18.4.2 Interface with Indian Railways

1) Items of interface With Indian Railways

Interfacing with Indian Railways will be required for:

- a. Power Supply Interface at stations and line connecting to IR,
- b. Data / Details Required for Simulation Studies,
- c. OHE layout including provision of Neutral section and OHE interface point between HORC and IR
- d. Earthing of existing metallic structures of Railways in parallelism with HORC Line

2) Information Exchange

The System Contractor (SYS-1) shall share the system information and system design to establish compatibility with existing Indian Railway system

3) Interface requirements

The Interface requirements are described in **Table –18.4.2**.

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Table – 18.4.2

Interfacing Requirements with Indian Railways

Item No.	Item Description	System Works Contractor (SYS-1)	Indian Railways	Remarks
1	Power Supply Interface at Junction stations with IR	The PTFE neutral sections shall be provided at inter-connecting lines between HORC and IR lines as per rules and regulations in ACTM. OHE works pertaining to yard modification of IR at connecting stations will be carried out by Contractor (SYS-1). All released material arising out of modifications shall be handed over to IR.	IR will allow access and grant necessary power blocks to integrate the HORC lines with the yard lines of IR at junction stations.	Yards of connecting stations to HORC.
2	OHE layout including provision of Neutral section and OHE meeting point between HORC and IR	The OHE layout at all junction stations covering OHE meeting point shall be coordinated with IR. This shall also require provision of jumpers at the overlaps and checking and adjusting levels at the alignment of OHE for smooth movement of LOCOMOTIVES.	IR shall approve the OHE layout for connecting Chord at crossing stations. IR shall allow access and grant power block to the contractor (SYS-1) at the time of execution, testing and commissioning. Cost of Power & Traffic Block, if any, shall be borne by HRIDC. However, if any penalty becomes leviable on account of late cancellation of Block or otherwise due to any other reasons, shall be payable by the contractor (SYS-1).	Along the route at interface point.
3	Data / Details Required for Simulation Studies	The system Contractor (SYS-1) shall liaise with IR for seeking details of Rolling Stock/ LOCOS required for simulation for Traction and EMI/EMC studies	IR shall provide the details as required for the Simulation study.	

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Item No.	Item Description	System Works Contractor (SYS-1)	Indian Railways	Remarks
4	Electromagnetic Compatibility	Shall conduct EMC Study and share the study report with IR details.	IR shall coordinate jointly with Traction Electrification, E&M and Associated Works Contractor (SYS-1) to ensure compatibility.	Electro-magnetic Compatibility
5	Earthing of existing metallic structures of Railways in parallelism with HORC Line	Shall ensure earthing of fencing and other metallic structure of Railways line (wired or unwired) adjacent and parallel with HORC's 2X25 kV OHE by means of two separate and distinct earth connections with BEC (if required).	Shall provide list and drawings of fencing and other metallic structures running parallel to the HORC's track for long distances, Shall coordinate HORC's System Contractor (SYS-1) for suitable earthing connections.	Crossing Stations
6	Modifications in Harsana Kalan IR SSP and feeders from Harsana Kalan IR SSP to New Harsana Kalan OHE	PSI works pertaining to SSP modification at Harsana Kalan IR SSP and Feeders connecting Harsana Kalan IR SSP to New Harsana Kalan OHE will be carried out by Contractor (SYS-1). Provision of RTU and upgradation work at IR RCC for SCADA shall be done by SYS-1 Contractor. All designs and drawings shall be prepared and shall be approved by Engineer and IR.	IR shall approve the Harsana Kalan SSP modification work and feeder work and SCADA work. IR shall allow access and grant power block to the contractor (SYS-1) at the time of execution, testing and commissioning. Cost of Power & Traffic Block, if any, shall be borne by HRIDC. However, if any penalty becomes leviable on account of late cancellation of Block or otherwise due to any other reasons, shall be payable by the Contractor (SYS-1).	Harsana Kalan SSP and feeders.

18.4.3 Interface with Power Supply Authorities: for 220/132 kV Power Supply.

1) Items of interface with State Power Authority

Interfacing with the State Power Authority will be required for;

- a. Power Supply Interface at Traction Substations (TSSs),
- b. 220/132 kV incoming gantry to allow termination of three phase transmission line.
- c. Protection Coordination with State Power Authority,
- d. Shall share Design data regarding short circuit level, harmonic suppression, and ascertain that these data is used for system design.

2) Information Exchange

The System Contractor (SYS-1) shall share the information related to protection coordination and system design to establish compatibility with State Power Authority.

3) Interface requirements

The Interface requirements are described in **Table –18.4.3**.

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Table – 18.4.3

Interfacing Requirements with : State Power Authority

Item No.	Item Description	System Works Contractor (SYS-1)	State Power Authority	Remarks
1	220/132 kV Incoming Bay	Shall provide 220/132 kV incoming gantry to allow State Power Authority to terminate double circuit three phase transmission line inside the TSS.	Shall coordinate with HRIDC and with the System Contractor (SYS-1).	TSS
2	Design Data of Traction Installation	Shall propose a protection scheme and obtain approval from Power Supply Utilities: State Power Authority. Shall ascertain the adequacy of the provisions as per the requirements of State Power Authority and share Various design information viz. <ul style="list-style-type: none"> • TSS Protection Scheme & Relay coordination • Harmonic suppression, • short circuit level 	Shall verify and approve the final scheme of protection. Shall coordinate with HRIDC's System Contractor (SYS-1) and share the relevant information.	TSS/GSS
3	Metering Equipment	<ul style="list-style-type: none"> • Shall provide necessary check meters for measurement of voltage, current, p.f., kVA, kVARh, kWh, at TSSs. • Shall co-ordinate with State Power Authority for proper readings. • Transmit the Energy and power quality data to OCC. 	Shall provide necessary tariff meters for measurement of voltage, current, p.f., kVA, kVARh, kWh, at TSS as required.	TSS

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Item No.	Item Description	System Works Contractor (SYS-1)	State Power Authority	Remarks
4	Earthing	<ul style="list-style-type: none"> • Shall propose an earthing arrangement at the TSSs in consultation with State Power Authority. • Shall make necessary arrangement for earthing. 	Shall scrutinize and approve earthing arrangement.	TSS
5	Interface	<ul style="list-style-type: none"> • Issues on interaction during design, construction and execution should be resolved to the satisfaction of State Power Authority. • These issues may relate to metering, and on timing of completion, testing and commissioning. 	Shall coordinate with HRIDC and with the System Contractor (SYS-1).	TSS
6	Design consideration due to feed from State Power Authority transmission line network.	The Contractor Design Simulation as required should be undertaken in consideration of the source of power supply from State Power Authority.	State Power Authority will share the information regarding the sources of power supply including parameters of transmission line and feeding Grid Substations as required for design in case may be.	TSS
7	Control and Monitoring equipment at TSS	Shall provide space to install control panel cubicle and shall provide LV power supply to the State Power Authority at the TSS	Shall install control panel cubicle in the control room of HRIDC TSS	TSS

18.4.4 Interface with Indian Railway, DFCCIL and Contractor MSIL(OHE) for OHE at the boundary location

1) Interfacing with the Indian Railways, DFCCIL and Contractor MSIL(OHE) will be required for;

- a. Design of OHE, SCADA and Earthing & Bonding arrangements at boundary locations at:
 - (1) Sultanpur, Asaudah and New Harsana Kalan with Indian Railways.
 - (2) Pirthla with DFCCIL
 - (3) Patli with Contractor MSIL(OHE)
- b. Erection of OHE structure, Earthing & Bonding arrangements at boundary locations at Sultanpur, Asaudah, Harsana Kalan, Pirthla and Patli.

2) Information Exchange

The System Contractor (SYS-1) shall share the information of system design and establish compatibility in OHE and Earthing & Bonding arrangements at boundary location,

3) Interface requirements

The Interface requirements are described in **Table –18.4.4**

Part 2, Section VII-2: Employer's Requirements - Particular Specifications (PS)-for 2x25 kV, AC Traction electrification and associated works

Table – 18.4.4

Indicative Interface with Indian Railways, DFCCIL and Contractor MSIL(OHE) at boundary locations:-

Item No.	Item Description	System Contractor (SYS-1)	Indian Railways, DFCCIL and Contractor MSIL(OHE)
1.	Design and erection of OHE and Earthing & Bonding and SCADA arrangements at boundary locations at Sultanpur, Asaudah and New Harsana Kalan.	(i) Shall coordinate with IR for collecting as erected drawing of existing electrified line at Sultanpur, Asaudah and New Harsana Kalan. (ii) Shall coordinate and share the design for the common section to finalize the plan. Shall coordinate with Indian Railways for finalising the locations of portals and/or single line cantilever structures. (iii) If portals are required to be provided for the common section, Contractor (SYS-1) shall provide and install mast / structure as per design and as approved by the Engineer. (iv) Shall coordinate and provide SCADA controls at IR SCADA center.	IR on the request of HRIDC/Engineer will provide the power and Traffic Blocks to Contractor (SYS-1) for making changes in OHE as per approved drawing. The charges claimed by Indian Railways and DFCCIL for granting traffic/Power black etc, for yard modification work and OHE connection shall be borne by the Employer (HRIDC).
2.	OHE and SCADA arrangements at boundary locations at Patli station (IR) and Manesar HORC.	(i) Shall coordinate with IR and contractor MISL (OHE) for collecting as erected drawing of existing electrical (ii) Shall coordinate with Contractor MSIL(OHE) and install all equipments at OCC Manesar to control and monitor status of Patli SP.	Contractor MSIL(OHE) shall coordinate with Contractor (SYS-1) and provide all SCADA system of Patli SP to Contractor (SYS-1) who shall provide all controls and indications of Patli SP at OCC, Manesar.

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Item No.	Item Description	System Contractor (SYS-1)	Indian Railways, DFCCIL and Contractor MSIL(OHE)
3.	OHE and SCADA arrangements at boundary locations at Prithla SP	(i) Shall coordinate with DFCCIL and provide SCADA controls and indications of Prithla SP as per DFCCIL requirements (OCC of DFCCIL).	Shall coordinate with Contractor (SYS-1) and give their SCADA system requirements of Prithla SP which are essential for DFCCIL for control and indications purpose.

(End of Chapter 18)

CHAPTER 19 –APPENDICES ON ABBREVIATIONS,SPECIFICATIONS

INDEX

Appendix No.	Description
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7.	CORE's Drawings
8.	Specifications of 60/84/100 MVA Scott connected Traction Transformer
9.	Specifications of 8-MVA Auto-Transformer (based on which the Specification for higher Capacity MVA Auto Transformer shall be drawn by the Contractor covering all aspects.)
10.	Joint Deed of Undertaking by the Qualified Equipment Manufacturer along with the Contractor and Indian Equipment Manufacturer/Indian Partner
11.	Access Control System

Definitions

Terminology	Explanation/definition
Acceptance Measurement	Final definitive records of the measurement of the installed contact wire heights and staggers at OCS support and at mid-spans.
Accessible voltage (Vacc)	The part of the rail potential under operating conditions that can be bridged by persons, the conductive path being conventionally from either hand to both feet through the body, or from hand to hand.
Aerial Earth Wire	A conductor on traction masts/structures/ supports and bonded to their metallic parts/ supports and connected to earth.
Auto Transformer	A transformer with a single winding that is Centre tapped to provide a zero potential traction return connection. The +25kV terminal is connected to the catenary and the -25kV terminal is connected to the autotransformer feeder or negative feeder.
Auto Transformer Station	A building or compound containing electrical switchgear, equipment and autotransformer(s) which are arranged to connect together a number of sections of overhead line equipment.
Auto-Tensioned Equipment	OCS conductors terminated with Auto Tensioning device with balance weights, springs or hydraulic tensioning devices to maintain constant tension.
Bonding	The electrical connection of two or more conductive parts to ensure a continuous path for electric current, or to maintain the connected parts at substantially the same potential.
British Standard	A standard published by the British Standards Institution. Its alphanumeric identity is prefixed by BS.
Common Bonding Network (CBN)	The CBN is the principle means for effecting bonding and earthing inside a building. It is the set of metallic components that are intentionally or incidentally interconnected to form the principal bonding network in a building. These components include: structural steel or reinforcing rods, metallic plumbing, AC power conduit, cable racks and bonding conductors.
Cross-Bond	In addition to longitudinal-bond on each track, the two tracks are bonded together via Traction Spider Plates.
Earth Electrode	A conductive part or a group of conductive parts in intimate contact with and providing an electrical connection to earth.
Earth Mat	A group of conductor rods connected together as a grid, with or without earthing electrodes normally connected at the grid points.

Terminology	Explanation/definition
Earth Wire	A conductor electrically connecting together the steelwork of two or more overhead line structures or a number of overhead line small-part steelwork assemblies and bonded to a traction return rail or to the Centre tap of an impedance bond.

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Earth	The conductive mass of the earth, whose electric potential at any point is conventionally taken as equal to zero.
Electrical Section	A length of overhead line equipment between switching stations or between a switching station and a terminal end.
Electrification System	Electric power distribution system along track which can be on side rails or overhead and distributes power from Feeder Stations to the train's current collection system.
Equipotential Bonding	Electric connections ensuring that exposed conductive parts and all extraneous conductive parts are maintained at substantially equal potential.
European Standard	A standard published by the European Committee for Standardization or by the European Committee for Electro-technical Standardization. Its alphanumeric identity is prefixed by 'EN'.
Fault Current	The current that flows as a result of an unintentional electrical fault on the electrification system, such as a short circuit or flashover.
Feeding Section	A feeding section is defined as the section of overhead line between successive TSS/SP on either side of a feeder station.
First Emergency Feeding	The feeding arrangement when one of two feeder circuits to the feeder station has failed (in the case where the feeder station is fed by two feeder circuits). For feeder stations with one feeder circuit, the feeder circuit shall be used to T-feed the sections in both directions. In the latter case, normal and first emergency feeding arrangements are the same.
International Standard	A standard published by the International Electro-technical Commission. Its alphanumeric identity is prefixed by 'IEC'.
Load Current	The current that flows as a result of the operation of electric trains.
Metallic Service	A service having an exposed metallic surface, such as a gas or water pipe, a conduit, or a metal-sheathed cable.
Normal Feeding	The feeding arrangement when both 132 kV feeder circuits to the Traction Sub-station are healthy and available for service. All feeder circuits shall be used to radial feed their respective sections with a neutral section between them.

Terminology	Explanation/definition
Overhead Contact line Zone	The zone whose limits are not exceeded, in general, by a live, broken overhead line conductor. The term applies to out-of-running overhead line conductors but not to those conductors that are not mechanically strained by pantographs, because the probability of breakage is too small. The profile and dimensions of the zone are defined in BS EN 50122-1. See also pantograph zone.
Pantograph Zone	The zone whose limits are not exceeded, in general, by a live, broken or de-wired pantograph. Its profile and dimensions are

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	defined in BS EN 50122-1. See also overhead contact line zone.
Rail Potential	The voltage occurring between the traction return rails and earth under operating conditions and or under fault conditions.
Return Conductor	A conductor connected in series with the secondary windings of booster transformers, and bonded to the traction return rails to carry traction return current back to a feeder station independently of the running rails. However here it will be referred interchangeably as Negative feeder or Return conductor or Return feeder.
Second Emergency feeding	The feeding arrangement when both the feeder circuits to the feeder station have failed (in the case where the Feeding Station is fed by two feeders circuits), or when the single feeder to the feeding station has failed (in the case where the Feeding Station is fed by a single feeder circuit). The affected sections are fed by the adjacent feeder stations.
Simultaneous Touching Distance	The distance which can be bridged by a person. In general a minimum horizontal dimension of 2m and a minimum vertical dimension of 2.5m are adopted.
Stray Current	Electric current that follows paths other than intended paths. Stray currents occur in A.C. traction systems but only d.c. stray current is corrosive to steel structures.

Terminology	Explanation/definition
Touch Potential, Touch Voltage (V _{touch})	The electrical potential difference between two parts at different electrical potentials under fault conditions that is experienced when touched.
Traction Power Supply System	The Traction Power supply System is defined as the Infrastructure between the point of common coupling with Power Supply Utilities and the pantograph of the Locomotive and Rail.
Project Wide	Project Wide is defined as HORC Project Prithla – New Harsana Kalan section and includes all contractors working on the section like CST (Civil and Track work – contractor)
Proven	The proposed system / equipment to be used should be of proven performance and record of at least two years. The same should have been in use in adequate numbers (at least two unless specifically asked more) in Metro / Railway system or Power Utilities.

Appendix-2

Abbreviations

AC	Alternating Current
ACO	Automatic change over switch
ACS	Access Control (Rail System)
ACTM	Alternating Current Traction Manual
AMS	Asset Management System
AT	Auto Transformer
ATS	Auto Transformer Stations
ATD	Auto Tensioning Device
Aux	Auxiliary
BIS	Bureau of Indian Standards
BWA	Balance Weight Assembly
CB	Circuit Breaker
CEA	Central Electricity Authority – Government of India
CORE	Central Organization for Railway Electrification
CBT	Computer Based Training
DFC	Dedicated Freight Corridor
DFCCIL	Dedicated Freight Corridor Corporation India Limited
DSC	Double Stack Container
DLP	Defect Liability Period
EPDM	Ethylene Propylene Diene Monomer
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
FMECA	Failure modes, effects and criticality analysis
FOB	Foot Over Bridge
GS	General Specifications
GSS	Grid Substation
HF	Human Factors
HFIP	Human Factors Integration Plan
HV	High Voltage
I/O	Input/ output
IR	Indian Railway
IEC	International Electro-technical Commission
IEEE	Institute of Electrical and Electronic Engineers Inc.
IPR	Intellectual Property Rights
IS	Indian Standards

LV	Low Voltage
MMD	Maximum Moving Dimension
MPCC	Main Power Control Centre
MOU	Memorandum of Understanding
OCS	Overhead Contact System
OFC	Optical Fibre Cable
OHE	Overhead Equipment
ONAN	Oil Natural Air Natural
ONAF	Oil Natural Air Forced
PCB	Poly Chlorinated Biphenyls
PDF	Portable Document Format
PHA	Polycyclic Aromatic Hydrocarbons
PLC	Programmable Logic Controllers
PS	Particular Specifications
RAM	Reliability, availability and maintainability
RAMS	Reliability, availability, maintainability and safety
RBD	Reliability Block Diagram
RDSO	Research Design and Standard Organization under the Ministry of Railways
RTU	Remote Terminal Unit
ROW	Right of Way
SCADA	Supervisory Control and Data Acquisition
SQE	Safety, Quality and Environment
SSP	Sub-Sectioning Post
SP	Sectioning Post
SCP	Supply Control Post
SPS	Small Part Steelwork
SSOD	Standard Schedule of Dimensions
SAT	Site Acceptance Test
TBA	To be advised
TSS	Traction Substation
TOT	Transfer of Technology
XLPE	Cross Linked Polyethylene

List of Indian Standards (IS)

Sr.	Number of IS	Description
1.	226-1975 814-1974 816-1969 823-1964 6227-1971	Structural steel (standard quality) Specification for mild steel and tinsplate drums Code of practice for use of metal arc welding for general construction in mild steel Code Of Procedure For Manual Metal Arc Welding Of Mild Steel Code Of Practice For Use Of Metal Arc Welding In Tubular Structure
2.	269-1989 (4th rev.)	Specifications for 33 grade ordinary Portland cement.
3.	335-1993	New Insulating Oils.
4.	383-1970 & 515-1959	Fine & coarse aggregates for concrete.
5.	432-1982	Specifications for mild steel and medium tensile steel bars and hard drawn steel wires for concrete reinforcement.
6.	694-1990	PVC Insulated cables for working voltages up to and including 1100 Volts.
7.	1248-2003	Direct Acting Electrical Indicating Instruments.
8.	1554-1988	PVC Insulated (Heavy Duty) Electric Cables
9.	1753-1967	Aluminium conductors for insulated cables.
10.	2099-1986	Bushing for Alternating Voltages Above 1000V (2nd Revision).
11.	2705-1992	Current Transformers.
12.	2834-1986	Shunt Capacitors for Power Systems
13.	3043-1987	Code of Practice for Earthing.
14.	3156-1992/4146-1983	Voltage Transformers / Application Transformers .Guide for Voltage
15.	3231	Electrical Relays for Power System Protection.
16.	3401-1992	Specifications for Silica Gel.
17.	3427-1997	Metal Enclosed Switchgear & Control Gear for Voltages Above 1000V up to and Including 52000V.
18.	3639-1966	Fittings and accessories for power transformers.
19.	3842	Application guide for electrical relays for ac systems
20.	3961-1968 (Part III)	Recommended current ratings for cables.
21.	5138-1978	Enclosure construction with single Sheet sturd frame construction.
22.	5216	Recommendations on Safety Procedures and Practices in Electrical Work.
23.	5891-1970	Recommended Short Circuit Rating of High Voltage XLPE Insulated PVC Cables.
24.	6600-1972 /	Guide for Loading of Oil Immersed Transformers.
25.	10561-1983/	Application Guide for Power Transformers.
26.	10593-2006	Mineral Oil-impregnated electrical equipment in services -Guide to the interpretation of dissolved and free gases analysis.

List of International Standards (DIN/EN/BS/IEC/IEEE/ISO/UL etc.)

S. No	Standard Number	Description
1.	BS 5308	Instrumentation cables–Part1 Specifications for polyethylene Cables
2.	BS 7671	Requirements for Electrical Installations.
3.	BS 7835	Specifications for cables with cross-linked polyethylene or ethylene propylene rubber Insulation for rated voltages from 3800/6600 V up to 19000/33000 V having low emission of smoke and corrosive gases when affected by fire.
4.	BS EN 50082-1	Electromagnetic compatibility - Generic immunity standard Part 1: Residential, commercial and light industry.
5.	DD ENV 50121 (All parts)	Railway applications - Electromagnetic compatibility.
6.	DIN 43668	Key for the doors of electrical switchgear cubicles and cabinets; double-bit key.
7.	DIN 43671	Copper bus bars; design for continuous current.
8.	DIN 43761	Temperature Sensors.
9.	DIN 53504	Tensile strength.
10.	DIN 53577	Compressive strength.
11.	DIN EN 13601	Copper rod, bar and wire for general electrical purposes.
12.	EN ISO 9001	Quality systems: Model for quality assurance in design, development, production, installation and servicing.
13.	EN 50119	Railway Applications - Fixed installations- Electric traction overhead lines.
14.	EN 50121	Railway applications - Electromagnetic compatibility.
15.	EN 50122	Railway Application - Fixed Installations, Electrical Safety, Earthing and return circuit.
16.	EN 50124-1	Insulation Co-ordination in Traction Systems.
17.	EN 50125-2	Environmental Conditions for Fixed Installations.
18.	EN 50126	Railway applications: The specifications and demonstration of dependability, reliability, availability, maintainability and safety (RAMS).
19.	EN 50149	Railway applications. Fixed installations. Electric traction. Copper and copper alloy grooved contact wires.
20.	EN 50152	Railway Applications- Fixed Installations - Particular requirements for AC Switchgear. (All parts).
21.	EN 50522	Earthing of Power System exceeding 1 kV/ac
22.	EN 50163	Railway Application - Supply Voltages of traction systems.
23.	EN 50272 (Part 2)	Safety requirements for secondary batteries and battery installations - Stationary batteries
24.	EN 50329	Railway applications. Fixed installations. Traction transformers.
25.	EN 60051	Direct acting indicating analogue electrical measuring instruments and their accessories.
26.	EN 60076	Power Transformers / Reactors
27.	EN 60137	Insulated Bushings for Alternating Voltages above 1kV.

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28.	EN 60417	Graphical symbols for use on equipment.
29.	EN 60507	Artificial pollution tests on high-voltage insulators to be used on ac systems.
30.	EN 60529	Specifications for the degree of protection provided by enclosures (IP code).
31.	EN 60721	Classification of environmental conditions. Environmental parameters and their severities.
32.	EN 60896-2	Stationary lead-acid batteries. General requirements and methods of test. Valve regulated types.
33.	EN 61140	Protection against shock – Common aspects for installation and equipment.
34.	EN 61230	Live Working – Portable Equipment for Earthing or Earthing and short circuiting.
35.	EN 61325	Insulators for Overhead Lines with Nominal Voltages above 1000 V.
36.	EN 61508	Functional safety of electrical/ electronic/ programmable electronic safety related systems.
37.	EN 61952	Insulators for overhead lines. Composite line post insulators for alternating current with a nominal voltage.
38.	EN 62271	High-voltage switchgear and control gear.
39.	IEC Hand Book for Temperature Index	Cable in fire regarding temperature Index Chapter-6.
40.	IEC 60068	Environmental Testing
41.	IEC 60296	Bushings for alternating voltages above 1000 Volts.
42.	IEC 61508	Functional Safety – Programmable Safety related systems.
43.	IEC 60044	Instrument transformers – current transformers.
44.	IEC 60076	Power Transformers.
45.	IEC 60255	Measuring Relays and Protection Equipment.
46.	IEC 60376	Specifications of technical grade Sulphur Hexafluoride (SF6) for use in electrical equipment.
47.	IEC 60502	Power Cables - Extruded Insulation for rated voltages from 1 kV up to 30 kV.
48.	IEC 60616	Terminal and tapping markings for power transformers.
49.	IEC 60850	Railway applications – Supply voltages of traction systems.
50.	IEC 61000	Electromagnetic compatibility.
51.	IEC 61243	Line working - Voltage Detector.
52.	IEC 62128	Railway applications - Fixed installations - Part 1: Electrical safety, earthing and return circuit.
53.	IEC 62236	Railway Applications – Electromagnetic Compatibility.
54.	IEC 62271	High Voltage Switchgear and Control Gear above 53 kV.
55.	IEC 62695	Traction Transformers.
56.	IEEE80:2013	Guide for safety in ac substation grounding.
57.	IEEE 81	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potential of a Grid System.
58.	IEEE 485	IEEE Recommended Practice for Sizing of Large Lead Storage Batteries for generating Station and Substations.
59.	IEEE 738	Standard for Calculating Current-Temperature of Bare Overhead

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		Conductors.
60.	IEEE 980	Guide for Containment and Control of Oil Spills in Substations.
61.	IEEE 1187	Recommended Practice for Installation Design and Installation of Valve-regulated Lead acid Storage batteries for Stationary Applications.
62.	IEEE 1188	IEEE Recommended Practice for Maintenance, Testing and Replacement of valve-regulated Lead Acid (VRLA) Batteries for Stationary Applications.
63.	IEEE 1189	IEEE Guide for Selection of Valve-regulated Lead Acid (VRLA) Batteries for Stationary Applications.
64.	IEEE 1313.1	Standard for Insulation Coordination
65.	IEEE C2	National Electrical Safety Code.
66.	IEEE C37.30	Standard requirements for High-Voltage Switches.
67.	IEEE C37.32	HV switches, Bus Supports and Accessories, Schedule of Preferred Ratings, Construction Guidelines and Specifications.
68.	IEEE C37.37	Standard Loading Guide for AC HV Air switches (in excess of 1000V).
69.	IEEE C57.93	Guide for Installation of Liquid Immersed Power transformers.
70.	IEEE C95.1	Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
71.	IEEE C95.6	Standard for Safety Level with respect to Human Exposure to Electromagnetic Fields 0-3 kHz.
72.	IEEE 525	Guide for installation of cable systems in substations
73.	IEEE 979	Guide for substation Fire protection
74.	IEEE 998	Guide for direct Lightning stroke shielding of substations
75.	ISO 3864	Graphical symbols -- Safety colours and safety signs.
76.	ISO 17398	Safety colours and safety signs.
77.	NEC 300-21	Spread of Fire or Products of Combustion.
78.	NEMA 250	Enclosures for Electrical Equipment.
79.	NEMA AB1	Moulded Case Circuit Breakers and Moulded Case Switches.
80.	NEMA BU1	Bus ways.
81.	NEMA SG5	Power Switchgear Assemblies.
82.	NEMA SG6	Power Switching Equipment.
83.	NEMA TR208	Disconnect Switchgear Insulators.
84.	NFPA 70	National Electrical Code.

List of RDSO Specifications

S. No	Specifications No.	Description
1	ETI/OHE/3	Technical specifications for Annealed stranded copper conductors for jumper wire for Electric Traction.
2	ETI/OHE/11	Specifications for steel tubes.
3	ETI/OHE/13	Specifications for Hot dip zinc galvanization of steel masts (Rolled & Fabricated), tubes and fittings used on 25kV ac OHE.
4	ETI/OHE/16	Specifications for 25kV ac single pole and double pole isolators for Railway Electrification.
5	ETI/OHE/18	Specifications for Steel and stainless steel bolts, nuts and washers.
6	ETI/OHE/21	Aluminum alloy section and tubes for 25kV Traction Overhead Equipment.
7	ETI/OHE/27	Section Insulator assembly without sectioning insulator.
8	ETI/OHE/33	Specifications for Enameled steel plates.
9	ETI/OHE/33A	Provisional specifications for "retro-reflective structure Number plates."
10	ETI/OHE/36	Specifications for Galvanized steel wire rope.
11	ETI/OHE/42	Technical specifications for hard drawn grooved contact wire for electric traction (jointed/welded contact wire).
12	ETI/OHE/48	Technical specifications for Winch type regulating equipment for 25kV ac traction.
13	ETI/OHE/49	Technical specifications for Fittings for 25 kV ac OHE.
14	ETI/OHE/50	Technical Specifications for cadmium copper conductors for overhead Railway traction.
15	ETI/OHE/51	Specifications for Discharge/earthing pole assembly for 25kV ac traction.
16	ETI/OHE/52	Specifications for Interlocks for ac traction switchgears.
17	ETI/OHE/53	Principles for OHE layout plans and sectioning diagrams for 25kV ac traction.
18	ETI/OHE/54	Specifications for 19/2.79mm all aluminum alloy stranded catenary wire.
19	ETI/OHE/55	Specifications for Bimetallic (aluminum-copper) strip.
20	ETI/OHE/58/1	Specifications for hand operated lifting and swiveling platform.
21	ETI/OHE/64	Specifications for solid core cylindrical post insulators for systems with nominal voltages of 220kV, 132kV, 110kV & 66kV.
22	ETI/OHE/65	Specifications for continuous cast copper wire rods.
23	ETI/OHE/71	Code of bonding and earthing for 25kV ac 50Hz single phase

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		tractionsystem.
24	ETI/OHE/76	Technical Specifications for hard drawn grooved contact wire for electric traction drawn out of continuous cast copper (ccc) wire rods.
25	ETI/PSI/1	Battery charger for 110 volt battery, 40 Ah.
26	ETI/PSI/14	Technical specifications for 25kV drop out fuse switch and operating pole for use with 110kVA and 100kVA, 25k/240V LT supply transformers.
27	ETI/PSI/15	Specifications for 25kV/240V, 5 kVA, 10kVA, 25kVA & 50kVA, 50 Hz, single phase, oil filled auxiliary transformers for Railway AC traction system.
28	ETI/PSI/15A	25kV/240V L.T. supply Transformer, 100kVA.
29	ETI/PSI/24	Battery charger for 110V Battery, 200 AH.
30	ETI/PSI/29	Low tension Distribution panels for Railway A.C traction sub-stations.
31	ETI/PSI/31	Standard for Drawings for power supply Installations.
32	ETI/PSI/63	Low tension distribution panels.
33	ETI/PSI/71	Metal oxide gapless type lightning arrester for use on 25 kV side of Railway traction substations and switching stations.
34	ETI/PSI/90	25 kV ac 50 Hz single phase oil filled current transformers with ratio of (i) 1000-500/5A, (for general purposes), (ii) 1500-750/5 (for heavyduty).
35	ETI/PSI/117	Technical specifications for current transformers:I. 220kV. 200-100/5A, II. 132kV. 400-200/5A, III. 110kV.400-200/5A, IV. 66kV.800-400/5A for Railway A.C traction substations.
36	ETI/PSI/120	Code of practice for earthing of power supply installations for 25kV ac,50 Hz, single phase traction system.
37	ETI/PSI/122	Technical Specifications for 245 kV, 145 kV, 123 kV, 72.5 kV, Double Pole & Triple Pole Isolator for Railway Traction Sub-Stations.
38	ETI/PSI/123	8MVA, 54kV 50Hz, Auto Transformer for Railway 2 x 25kV AT Feeding System.
39	ETI/PSI/124	54 MVA, 220/2 x 27kV Scott connected Traction Power Transformer for 27 kV AT feeder system for Railway ac Traction Sub-station.
40	ETI/PSI/132	25 kV double pole outdoor, vacuum interrupters for Railway switching stations for 2x25 kV 'AT' feeding system.
41	ETI/PSI/133	25kV ac Double Pole Isolators for 2 x 25kV AT feeding system.

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42	ETI/PSI/137	Metal oxide gapless type lightning arresters for use of 220/132/110/66kV side of railway ac traction substation.
43	ETI/PSI/167	25kV AC 50Hz single pole, outdoor interrupter for Railway tractionswitching stations.
44	RE/30/OHE/5	Specifications for Copper bus bar.
45	RE/OHE/25	Standard for Drawings for Traction Overhead equipment.

S. No	Specifications No.	Description
46	RDSO/PE/SPEC/AC/0100,(Rev.'1') - 2011	Technical Specifications for Double capped tubular T5 Fluorescentlamps, T5 luminaire & Electronic ballast.
47	RDSO/PE/SPEC/T L/ 0040-2003 (Rev-0)	Specifications for low maintenance lead acid batteries for 40 Amphour and 200 Amp hour cells for traction distribution system.
48	TI/SPC/LWTSI/0060	Specifications for light weight section insulator assembly.
49	TI/SPC/OHE/ATD/0060	Specifications for Three pulley type regulating equipment (3:1 Ratio).
50	TI/SPC/OHE/FRPNP/INS/COM/ 1070	Technical specifications for silicon composite insulators for 25kV ac50Hz single phase overhead traction lines.
51	TI/SPC/OHE/GAL STB/0040	Technical specifications for galvanized steel stranded wire for tractionbonds for 25kV ac Electric traction systems.
52	TI/SPC/OHE/GATD/0080	Technical specifications for gas auto tensioning device.
53	TI/SPC/OHE/GSS W/0090	Schedule of technical requirements for manufacture of Galvanizedsteel stranded wire (GSSW).
54	TI/SPC/OHE/HDCSC F/0030	Technical specifications for 37/2.25mm Hard Drawn Stranded copperconductor.
55	TI/SPC/OHE/INS/0070	Specifications of solid core porcelain insulators for 25kV A.C 50 Hzsingle phase overhead traction lines.
56	TI/SPC/OHE/INS/0700	Specifications for stainless steel wire rope.
57	TI/SPC/OHE/INSCA T /0000	Insulated Cadmium Copper Catenary 19/2.1mm. Diameter for provision under overhead line structures in the 25kV ac Electric Traction.
58	TI/SPC/OHE/INSTES T/0090	Specifications for Testing load testing machine 25kV Porcelain &Composite insulator before installation.
59	TI/SPC/OHE/POST/0100	Specifications for solid core porcelain cylindrical post insulator forsystems with nominal voltage of 66kV, 110kV, 132kV & 220kV.

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60	TI/SPC/OHE/SNS/ 0000	Specifications for short Neutral section assembly (Phase Break).
61	TI/SPC/OHE/WR/1 06 0	Specifications for solid porcelain insulators for 25kV ac 50hz singlephase overhead traction lines.
62	TI/SPC/PSI/CB/000 0	Outdoor Circuit Breaker for Railway ac Traction Sub-stations.
63	TI/SPC/PSI/FC&SR/ 0100	Technical specifications for shunt capacitor & series reactor equipment for traction sub-station.
64	TI/SPC/PSI/ISOLTR/ 1060	25kVac Single Pole and Double Pole Motorized Isolators for Railway Traction.
65	TI/SPC/PSI/MOGTL A /0100	42 KV Metal oxide gapless type lightning arrester for use on 25 KV side & Railway Traction substation and Switching Station.
66	TI/SPC/PSI/PROTC T /1982	Specifications for Delta-I type High Resistive fault selective relay for 25 kV ac traction systems.
67	TI/SPC/PSI/PROTC T /2983	Specifications for Panto Flashover Protection relay for 25 kV ac traction System.
68	TI/SPC/PSI/PROTC T /6070	Control and relay panel for 25kV ac TSS including specifications for numerical type protection relays for traction transformer, 25kV shunt capacitor bank and transmission line for 25kV AC TSS on Indian Railways.
69	TI/SPC/PSI/PROTEC T/7100	Technical specifications for control and relay panel including numerical type protection relays for Scott-connected/single phase traction transformers, OHE protection and shunt capacitor bank protection for 2x25 kV traction sub-station.
70	TI/SPC/PSI/PTs/09 9 0	Technical specifications for 220kV or 132kV or 110kV or 66kV or 25kV potential transformer.
71	TI/SPC/PSI/VACIN T/0040	Magnetic actuator type 25 kV ac, 50 Hz, single pole, outdoor vacuum interrupter for railway traction switching Station.
72	TI/SPC/RCC/SCAD A / 0130 (Rev-2)	Specifications for SCADA
73	TI/SPC/PSI/TRNPW R/5200	Technical specifications for 60/84/100 MVA ONAN/ONAF/OFAF 220/132kV/2x55 kV Scott- connected Traction Power transformer.
74	TI/SPC/PSI/AUTOT R/1200	Technical specifications for 8 & 16.5MVA ONAN 55kV/27.5kV Autotransformer
75	TI/SPC/PSI/40-150/ CHGR/1210	Battery charger for 110 V battery, 150AH for (2x25 kV) and 40 AH (for 25 kV) at SP/SSP for Electric Traction Installation
76	TI/SPC/PSI/200- 250/CHGR/0210	Technical specification for Battery charger for 110 V battery, 200/250AH, at Traction Sub-station for 25kV/2x25 kV Electric Traction Installation

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77	TI/SPC/PSI/CT/0210 (07/2021) 40-150/CHGR/1210	Technical specification for Current Transformers with ratio of 220 kV, 400-200.5A and various others for Railway AC TRACTION SUBSTATIONS
78	TI/SPC/OHE/Fittings / 0130/(10/13) Rev.1	Technical specification for 25 kV AC OHE Fittings
79	TI/SPC/PSI/EARTHING/0210	Technical specification for Earthing of Power Supply Installations for 25 kV and 2x25 kV AC, 50 Hz Traction System.
80	TI/SPC/PSI/ISOLTR / 0210 (Addendum & corrigendum No.1)	Technical specification for 25 kV Motorised/Manual operated and 50kV/66kV/100kV/110kV/132kV/220kV Manual operated Single Pole, Double Pole and Triple Pole Isolators for Railway Electric Traction.
81	TI/SPC/PSI/HVCB/ 0121 (Addendum & corrigendum Slip No.1)	Specification for 220kV/132kV/110kV/100kV/66kV/55kV Double Pole, Triple Pole Outdoor SF6 Circuit Breaker for Indian Railway
82	RDSO/PE/SPEC/TL / 0040 (Rev.2) - 2021	Specification for Low Maintenance Lead Acid 40AH, 150AH, 200AH and 250AH Cells for Traction Distribution System.
83	TI/SPC/OHE/INSCOM/1072	Technical Specification for Silicone Composite Insulators for 25 kV, AC, 50 Hz, Single Phase Overhead Traction Equipment.
84	ETI/OHE/71 (11/90) – Rev.1	Code for Bonding and Earthing for 25 kV, AC, 50 Hz, Single Phase Traction System.
85	TI/SPC/PSI/PROTC T/7101	Technical specification for Control and Relay Panel Including Numerical type protection relays for Scott-connected/V-Connected Single-Phase Traction Transformers, OHE Protection, 55 kV AT Protection & Shunt Capacitor Protection for 2x25 kV Traction Sub-station, Sectioning and Paralleling Post, Sub-Sectioning & Paralleling Post, and Auto Transformer Post.
86	TI/SPC/OHE/POST/ 0101 (June, 2022)	Specification for Solid Core Porcelain Cylindrical Post Insulators for Systems with Nominal Voltage of 66kV, 110kV, 132kV & 220kV.
87	TI/IN/0038 (Feb, 2019)	Technical Instruction for Earthing practices on various types of Bridges.
88	TI/SPC/OHE/CAT (Cu-Cd)/0971	Technical Specification for Cadmium Copper Conductors for Over Head Electric Traction
89	TI/SPC/OHE/CW /0971	Technical Specification for Hard Drawn Grooved Copper Contact Wire for Electric Traction
90	TI/SPC/OHE/GALS TB/0040 Rev.1 (April, 2022)	Technical Specification for Galvanised Steel Stranded Wire for Traction Bonds for 25 kV AC, Electric Traction System
91	TI/SPC/OHE/INS/0071 (April, 2022)	Technical Specification for Solid Core Porcelain Insulators for 25 kV, AC, 50 Hz, Single Phase Overhead Traction Lines.
92	TI/SPC/OHE/STRIP (Al-Cu)0901 (January, 2021)	Technical Specification for Bimetallic (Aluminium-Copper) Strip.

**Part 2, Section VII-2: Employer's Requirements - Particular Specifications (PS)-for 2x25 kV, AC
Traction electrification and associated works**

93	TI/IN0041 (September, 2020)	Guidelines for Rigid Catenary Overhead Conductor System for use in Tunnels
94	TI/SPC/OHE/ HDCSCF/0031	Technical specification for Hard Drawn Stranded Copper Conductor
95	TI/SPC/PSI/ISOLTR /0210 (July, 2021)	Technical specification for 25 kV motorized/manual and 55/132/220 kV manual operated single pole, double pole, triple pole isolators.
96	TI/SPC/PSI/CLS/00 20 (amendment-4 or latest)	Technical specification for Control & Distribution panel for Colour Light Signalling supply and emergency loads in 25 KV AC traction System.
97	<i>Instruction no. TI/IN/0042</i>	<i>OHE guidelines for increasing speed potential to 160 kmph in NDLS-HWR & NDLS-BCT routes.</i>
98	<i>IS/RDSO – TI/0002 :2023</i>	<i>Indian Railway Standard for Power Quality Restorer (POR) for 25 kV and 2x25 kV Traction Installation in Indian Railways.</i>
99	<i>TI/SPC/PSI/PROTC T/7101</i>	<i>Technical Specifications for Control and Relay Panel Including Numerical type protection relays for Scott-connected/V-Connected Single-Phase Traction Transformers, OHE protection, 55 kV AT Protection & Shunt Capacitor Bank Protection for 2x25 kV Traction Sub-station, Sectioning and Paralleling Post, Sub-Sectioning & Paralleling Post and Auto Transformer post.</i>
100	<i>TI/SPC/OHE/3PHT ATD/0150</i>	<i>Technical Specification for Three Pulley Type Regulating Equipment with 2400 Kgf Tension in Overhead Conductor for 25kV AC Traction.</i>

List of RDSO Drawings

Sl. No	Brief Description	Drawing		Mod . No.
		Series	Number	
1	Typical location & schematic connection diagram for athree interrupter switching station.	ETI/PSI	003	C
2	Typical general arrangement of a three interrupterswitching station.	ETI/PSI	004	F
3	Typical location plan & general arrangement for sectioning & paralleling station.	ETI/PSI	005	F
4	Typical location plan and general arrangement for afeeding station.	ETI/PSI	006	E
5	Details of foundation for fencing upright.	ETI/C	0032	B
6	Details for pre-cast cable trench for switching station.	ETI/C	0038	E
7	Remote Control Cubical at station, Foundation, RCCSlab, building plant and steel door.	ETI/C	0067	B
8	Protective screen of foot-over bridge and road over-bridge.	ETI/C	0068	G
9	Typical fencing and anti-climbing arrangement at switching stations.	ETI/PSI	104	E
10	Typical fencing layout at TSS (Details of Fencingpanel, door, anti-climbing device etc.).	ETI/PS2	121	F
11	General arrangement & details of fencing panels &gate for switching stations.	ETI/C	0186 Sh.I& II	E
12	Typical earthing layout of sub- sectioning and paralleling station.	ETI/PSI	201	B
13	Typical Cable trench layout and foundation layout of132/ 25kV TSS.	ETI/C	0210	F
14	Details of baffle wall at TSS (WP-112.5 Kg f/m ² andWP-75 kg f/m ²).	E TI/C	0213	D
15	Details of RCC baffle wall at TSS (WP-150kgf/m ²).	ETI/C	0214	B
16	Transformer oil drainage arrangement at substations.	ETI/C	0216	B
17	Arrangement for false catenary under over line structure.	ETI/OHE/S K	446	--
18	Special arrangement of OHE under over line structure.	ETI/OHE/S K	529	--
19	Arrangement of overlap.	ETI/OHE/S	566	-

**Part 2, Section VII-2: Employer's Requirements - Particular Specifications (PS)-for 2x25 kV, AC
Traction electrification and associated works**

		K		
20	Typical arrangement of OHE with insulated coppercatenary under over line structure.	ETI/OHE/S K	570	--
21	Schematic arrangement of un-insulated over Lap (type-I) (3 & 4 Span overlaps).	RE/33/G	02121 Sh.1	F

**Part 2, Section VII-2: Employer's Requirements - Particular Specifications (PS)-for 2x25 kV, AC
Traction electrification and associated works**

Sl. No	Brief Description	Drawing		Mod . No.
		Series	Number	
22	Schematic arrangement of un-insulated overlaps (3 & 4 span overlaps).	ETI/OHE/G	02121 Sh.4	A
23	Schematic arrangement of insulated overlap.	ETI/OHE/G	02123 Sh.3	A
24	Schematic arrangement of insulated overlap.	ETI/OHE/G	02131 Sh.1	
25	General arrangement of regulated OHE at turn-outs(overlaps & crossed type).	ETI/OHE/G	02141	C
26	General arrangement of regulated OHE at cross over(overlap & crossed type).	ETI/OHE/G	02151	-
27	Arrangement of neutral section.	ETI/OHE/G	02161 Sh.1	C
28	Arrangement of short neutral section.	ETI/OHE/G	02161Sh.2	-
29	Arrangement of neutral section assembly (PTFE Type)at SWS.	ETI/OHE/G	02162	-
30	Standard termination of OHE (Regulated & un-regulated).	ETI/OHE/G	03121 (All parts).	E
31	General arrangement of connections to OHE by copper cross feeder (150).	ETI/OHE/G	05121 Sh.1	C
32	General arrangement of connections at switchingstation on double track section by copper cross feeder.	ETI/OHE/G	05122 Sh.1	C
33	General arrangement of connections at switching station on multiple track section by copper cross feeder.	ETI/OHE/G	05123 Sh.1	C
34	Arrangement of suspension of double spider 25 kV feeder and return feeder between sub-station and feeding station.	RE/33/G	05152	C
35	General arrangement of earth wire on OHE mast.	ETI/OHE/G	05201	A
36	Arrangement of transverse bonds.	ETI/OHE/G	05251	A
37	Suspension of 25kV feeder on OHE mast	ETI/OHE/G	05143	B
38	Standard span Height Gauge for level crossing (for clear span above 7.3 m up to 12.2 m)	TI/DRG/CI V/HGAUGE /- HR/RDSO	00002/20/0	-
39	Standard span Height Gauge for level crossing (for clear span up to 7.3 m)	TI/DRG/CI V/HGAUGE /- HR/RDSO	00001/20/0	-

List of CORE Drawings

(The listed Drawings of CORE are indicative and demonstrate the level of information and general description. The Equipment Support Structure and Foundations shall be designed as per the application duty requirement and the thermo dynamic stresses as may be witnessed by the equipment while operations or the Short Circuit Faults. The Manufacturer recommended Drawing will prevail subject to the local application duty, environment condition, soil bearing capacity and Insulation Coordination.)

Sl. No.	TITLE OF DRAWINGS	DRAWING NO.
1	Structural layout of 132/25 kV traction sub-stations.	ETI/C/0200, SH.No.-1 (Mod-H); SH.No.-2 (Mod-D)
2	Typical cable trench and foundation lay out of 132/25kv TSS.	ETI/C/0210 (Mod. F)
3	Line Diagram of Structural layouts of 220/25kV Traction sub-station.	ETI/C/0222
4	Structural layout of 220/27kV traction sub-station (Type-I).	ETI/C/0222-I
5	Characteristics of conductors/ bus bar for 25kV AC traction.	ETI/OHE/G/05600 (Mod. A)
6	Typical earthing, cable trench & foundation layout of 132/25kv TSS.	ETI/PSI/ 224 (Mod. E)
7	Typical layout of Remote Control cubicle at a switching station.	ETI/PSI/0010 (Mod. E)
8	Typical location plan and general arrangement for a feeding station.	ETI/PSI/006 (Mod. E)
9	Typical return current connection to buried rail at 132/25kv Traction sub-station.	ETI/PSI/0212-1 (Mod. NIL)
10	Typical layout for 25kv Shunt capacitor with series reactor to be installed at 132/25kv TSS.	ETI/PSI/0223 (Mod. E)
11	Typical general arrangement of earth screen wire termination at Traction substation.	ETI/PSI/0225 (Mod. C)
12	Typical schematic diagram of protection for single transformer traction sub-station.	ETI/PSI/0228-1 (Mod-NIL)
13	High speed auto reclosing scheme for feeder circuit breaker at 25kV A.C TSS.	ETI/PSI/0231-I (Mod A)
14	Typical layout of 132 /27kV traction substation (Type-I).	ETI/PSI/0230-1 (Mod. NIL)
15	Typical schematic diagram of protection for double Transformer traction substation.	ETI/PSI/024-1 (Mod. NIL)

**Part 2, Section VII-2: Employer's Requirements - Particular Specifications (PS)-for 2x25 kV, AC
Traction electrification and associated works**

16	Typical return current connection to buried rail at 132/25kV Traction sub-station.	ETI/PSI/0242 (Mod. A)
17	Typical general arrangement of earth screen wire termination at 132/25kV traction sub-station.	ETI/PSI/0244
18	Typical earthing layout of a feeding station	ETI/PSI/203 (Mod. B)
19	Typical earthing arrangement for equipment/ structure at TSS.	ETI/PSI/228 (Mod-A)
20	Schematic inter connection diagram for remote control of power gear & supervision equipment at TSS.	ETI/PSI/644 (Mod. C)
21	Schematic inter connection diagram for remote control of power gear and supervision equipment at controlled station (SP & SSP).	ETI/PSI/645 (Mod. C)
22	General scheme of supply for 25 kV 50 Hz single phase AC traction system.	ETI/PSI/702-1 (Mod. D& E) &
23	Control desk arrangement for 2 work stations of SCADA system.	ETI/PSI/SK/337
24	Arrangement of suspension of double spider 25kV feeder and return feeder between substation and feeding station	RE/33/G/05152 (Mod. C)
25	Standard plan of control room at traction sub-station (General arrangement and RCC details)	RE/Civil/S-144/06
26	Typical schematic diagram for TSS, FP, SSP and SP with 21.6 MVA or 30 MVA transformers for three lines.	TI/DRG/PSI/3L-TSS/RDSO/00001/ 07/1 (Mod-NIL)
27	Typical layout of Control Room at traction sub-station.	TI/DRG/PSI/CROOM/RDSO/ 00001/01/0
28	Typical layout of 132 /27kV Traction sub-station.	TI/DRG/PSI/TSSLO/RDSO/ 00001/01/0

**SPECIFICATION FOR 60/84/100 MVA, 220 kV /55 kV SCOTT-CONNECTED
TRACTION POWER TRANSFORMER FOR 2x25 kV AT FEEDING SYSTEM**

1. Scope

1.1. *This document applies to 60/84/100 MVA, ONAN/ONAF/OFAF, 220/55kV Scott-connected traction power transformers for Auto Transformer (AT) feeding system for installation in HORC.*

1.2. *The scott-connected traction transformer shall conform to RDSO Specification No. TI/SPC/PSI/TRNPWR/5200 (latest).*

1.3. **Spares**

The Contractor shall supply the following spares for 220 kV Scott -Connected transformers:

1. *One primary bushing complete with parts, fitting and bushing type current transformer.*
2. *One secondary bushing complete with parts, fitting and bushing type current transformer.*
3. *One complete set of gaskets of all sizes required for use in the transformer.*
4. *One breather unit with silica gel.*
5. *One piece of radiator.*
6. *One each of terminal connectors for primary and secondary side bushing terminals*
7. *One set of valves*
8. *One pressure relief device.*
9. *One set of primary, secondary and tapping coil*
10. *One complete off circuit motorized tap changer*

**SPECIFICATION FOR 8 MVA, 55 kV, 50Hz AUTO TRANSFORMER FOR 2 X 25 kV AT
FEEDING SYSTEM**

1 SCOPE

1.1 This document applies to 8 MVA, ONAN, 55/27.5 kV Auto Transformer for Auto Transformer (AT) feeding system for Installation in HORC.

1.2 The auto transformer shall be complete with all parts, fittings and accessories whether specifically mentioned herein or not, necessary for its efficient operation in an unattended traction substation. The auto transformer shall conform to RDSO specification No. TI/SPC/PSI/AUTOTR/1200 (latest).

1.3 Spares

The Contractor shall supply the following spares for Auto Transformers:

1. *Six line bushing complete with parts, fittings and bushing type current transformer.*
2. *Six neutral bushing complete with parts, fittings and bushing type current transformer.*
3. *Six complete set of gaskets of all sizes required for use in the transformer.*
4. *Six piece of radiator.*
5. *Six terminal connector each for line and neutral side bushing terminals.*
6. *Six set valves.*
7. *Six pressure relief device.*

Note: The Engineer shall distribute the above spares between Auto Transformers of traction sub-Station and Auto Transformers of SP/SSP

Appendix-10

**JOINT DEED OF UNDERTAKING BY THE QUALIFIED EQUIPMENT MANUFACTURER
ALONGWITH THE CONTRACTOR AND INDIAN EQUIPMENT MANUFACTURER/INDIAN
PARTNER**

THIS DEED OF UNDERTAKING executed this day of
Two Thousand and by

M/s., a Company incorporated under the laws of and
having its Registered Office at (hereinafter called the "*Qualified
Equipment Manufacturer*", which expression shall include its successors, executors and permitted
assigns),

And

M/s., a Company incorporated under the Indian Companies Act of 1956
and having its Registered Office at(hereinafter called the "*Indian Equipment
Manufacturer/Indian Partner*", which expression shall include its successors, executors and permitted
assigns),

Through

M/s., a Company incorporated under the laws ofand having its
Registered Office at (hereinafter called the "*Contractor*",
which expression shall include its successors, executors and permitted assigns),

in favor of M/s Haryana Rail Infrastructure Development Corporation Limited (HRIDC), a Company
incorporated under the Indian Companies Act of 1956 and having its office at Plot No. 143, 5th Floor,
Railtel Tower, Sector-44, Gurugram, Haryana-122003, India (hereinafter called the "*Employer*" which
expression shall include its successors, executors and permitted assigns).

WHEREAS:

1. The "*Employer*" has invited a bid as per its Tender Specification No.for
the execution of (*Insert name of the SYS-1 along with project name*).
2. The "*Contractor*" at the time of bidding has submitted its bid to the "*Employer*" vide proposal
No.dated.....for the said SYS-1 and accepted by the "*Employer*",
resulting into a contract (hereinafter called the "*Contract*").

1. The "Contractor" has selected "Qualified Equipment Manufacturer" along with its "Indian Equipment Manufacturer/Indian Partner", for the supply of Equipment, who is the qualified manufacturer of transformers in line with the Clause No....., Section, of Volume... forming part of the contract.

2. Under the provisions of the contract for the supply of the Equipment, the "Qualified Equipment Manufacturer" will supply _____ Nos. of Equipment "Indian Partner" will supply _____ Nos. of equipment.

NOW THEREFORE THIS UNDERTAKING WITNESSETH as under:

- 1.0 Without in any way affecting the generality and total responsibility in terms of this Deed of Undertaking, the Contractor, Indian Equipment Manufacturer/Indian Partner and the Qualified Equipment Manufacturer to ensure:
 - (i) Design of the Equipment manufactured in India shall be identical to the design of equipment to be manufactured and supplied by the Qualified Equipment Manufacturer.
 - (ii) Adequate up gradation of the facilities including quality systems at Indian works.
 - (iii) Training to staff of Indian Equipment Manufacturer/Indian Partner and certification to its trained personnel to carry out each activity.
 - (iv) Active involvement of Qualified Equipment Manufacturer expert in various stages of manufacturing such as for transformer winding manufacturing, core assembly, complete assembly, quality assurance and testing for the first unit of the Equipment at Indian Partner's works.
 - (v) MQP of Indian Equipment Manufacturer/ Indian Partner shall be same as that of Qualified Equipment Manufacturer.
 - (vi) Specification of raw material / major bought out components shall be same as that of Qualified Equipment Manufacturer.
 - (vii) Timely supply of the said equipment. In the event, the development takes time and does not meet the time schedule, Qualified Equipment Manufacturer shall supply all the equipment from their works to meet the completion schedule without any additional liability to the Employer.
 - (viii) If necessary the Qualified Equipment Manufacturer shall advise the Indian equipment manufacturer/Indian Partner and/or Contractor suitable modifications of designs and implement necessary corrective measures to discharge the obligations under the Contract.
 - (ix) The prototype tests shall be conducted for the equipment manufactured at the works of both i.e. Qualified Equipment Manufacturer as well as Indian equipment manufacturer/Indian Partner.

- 2.0 This Deed of Undertaking shall be construed and interpreted in accordance with the laws of India and the Courts in Delhi shall have exclusive jurisdiction in all

matters arising under the Undertaking.

3.0 We, the Qualified Equipment Manufacturer/Contractor and/or The Indian Equipment Manufacturer/Indian Partner agree that this Undertaking shall be irrevocable and shall form an integral part of the Contract and further agree that this Undertaking shall continue to be enforceable till the Employer discharges it.

IN WITNESS WHEREOF the Qualified Equipment Manufacturer, The Indian Equipment Manufacturer/Indian Partner and/or the Contractor have through their Authorized Representatives executed these presents and affixed Common seals of their respective Companies, on the day, month and year first above mentioned.

WITNESS

(For Qualified Equipment Manufacturer)

Signature

(Signature of the authorized representative)

Name

Name

Office Address

Common Seal of Company

WITNESS

**(For Indian Equipment
Manufacturer/Indian Partner)**

Signature

(Signature of the authorized representative)

Name

Name

Office Address

Common Seal of Company

WITNESS

(For Contractor)

Signature

(Signature of the authorized representative)

Name

Name

Office Address

Common Seal of Company

Note:

1. The non-judicial stamp papers of appropriate value shall be purchased in the name of executants parties and the date of purchase should not be later than six months of date of execution of the Undertaking.
2. The Undertaking shall be signed on all the pages by the authorized representatives of each of the partners and should invariably be witnessed.
3. In the event the Contractor is an Indian transformer Manufacturer/Indian Partner and the Collaboration is between Qualified Transformer Manufacturer and the Contractor, then the Joint deed of undertaking shall be modified accordingly.

ACCESS CONTROL SYSTEM

1. GENERAL

This section of the Specification identifies the Performance requirement of Access control system including design, supply, installation, testing and commissioning complete with all accessories for efficient and trouble-free operation.

The access control system shall be installed in the Control room Buildings of Traction substations, Switching Stations (i.e. TSS, SSP and SP etc.). The access control system shall be modular and expandable.

2 SCOPE OF WORK

Design, Supply, Installation, Testing and Commissioning of Access Control System and Security Alarm System for the following locations of Prithla – New Harsana Section of HRIDC:

- (1) Main Entry gates (TSS,SP & SSP);
- (2) Control Room building (TSS);
- (3) Tower Wagon Shed;
- (4) Electrical Room at Station;

3 FUNCTIONAL REQUIREMENTS

- (1) The main Workstation PC for access control system shall be kept in the OCC and security / control room of depot and substation (TSS, SP and SSP). It should be connected with Main network PC at OCC. The access to the System shall be limited by passwords. It shall be possible to generate Time & Attendance reports from the software and Daily Report (general), Daily Report (section wise).
- (2) The system shall be capable of supporting the latest technology free of risks of obsolescence such as Contactless Smart Card / Biometric finger scan/ Barcode encrypted.
- (3) The System shall have facilities to have restricted control of flow of persons, monitoring and /or control of fire escape doors, recording of attendance etc. as specified in the technical specifications.
- (4) The System shall have Access Control on the controlled Gates both at the Entrance and Exit. There shall be provision of prohibition of access through a gate in case the previous exit is not recorded and vice versa. This is to ensure that there is no piggyback entrance and/or exit.
- (5) The System will have provision to attend the alarms from Control Room at the Main Entry gate or elsewhere.

- (6) The system will have provision for automatic release of door in case of fire. The restrictive access of Access Control system will be overridden and all the controlled gates of affected rooms will be released permanently unless reset.
- (7) There will be provision of overriding the controlled access in case of an emergency by manual override from the security control room.
- (8) Each user shall be granted a unique a log in ID and Password.
- (9) Data Communication shall be Through RS 232 / 485 connectivity to facilitate interface with other systems.
- (10) The Access Control System shall have the emergency override facility to release open the locks in case of fire or any other emergency situation. Manual override is also to be provided by means of a manual glass break door release. Also a discreet key switch needs to be provided for manual override purpose.
- (11) Suitable cables will be laid in separate GI conduit for Signal and Power Supply from each controller to reader. The controllers of each building will be connected through independent communication cable, which is also in the scope of work.
- (12) The whole Access Control System shall be UL/FM/CE approved. The makes and nModel of the various subsystems/equipment shall be so selected that they are mutually compatible.

4 PERFORMANCE REQUIREMENTS

The performance requirement for the system shall be as below but not limited to:

4.1 Reliability

The Access system shall be designed with high reliability and single failure should not make the system non-functional.

4.2 Maintainability Requirements

All parts of the various subassemblies of the Equipment System shall be readily accessible and removable for maintenance and adjustment. The Equipment Systems shall be so designed as to ensure easy access for easy lubrication of the moving parts and at the same time meet the standard of ingress protection stipulated for that subassembly. The layout of the Equipment shall be so planned that the various subassemblies can be easily removed from their normally installed location for the purpose of cleaning, checking and readjustment of any mechanism. It shall be possible to replace critical components quickly and easily with spares held at site.

4.3 Environmental Condition Requirements

The contractor shall ensure that the entire key equipment of the system provided herein should meet environmental conditions:

Highest temperature: 50 degree C

Lowest temperature : (-) 5 degree C.

Indoor Equipment should be drip proof and outdoor should be splash proof.

(End of Chapter-19)

CHAPTER 20 – MAINTENANCE OF PSI, OHE AND SCADA WORKS

20.1 SCOPE

Contractor to carry out comprehensive maintenance of entire works under this Particular Specifications for a period of 3 (three) years from the date of taking of works by Employer. The maintenance will start from the day of start of Defect Notification Period (DNP). The maintenance requirement is completely different from DNP requirements and both should not be mixed. The work involves regular maintenance activities of PSI/OHE/SCADA systems from Prithla to Harsana Kalan section and connections to IR at Patli, Sultanpur, Asaudah and Harsana Kalan and connection from Prithla to New Prithla station of DFCCIL (145 RKM and 315 TKM). During the maintenance period Contractor to ensure that system works without any problem. All activities i.e regular, emergent and break down are covered under the scope. In case of damage to infrastructure due to accident by train, the contractor shall attend the restoration and all the cost of material shall be paid to the contractor by Employer as per cost related contract provisions but all manpower shall be arranged by contractor without any additional cost. The scope includes entire works mentioned in Employer's Requirements except modifications in Harsana Kalan IR SSP with SCADA and two Nos. 1x25kV feeders from Harsana Kalan IR SSP to New Harsana Kalan (HORC) OHE. The broad items of works are given in Sub-Cluse 20.2.

20.2 The items of work shall be as under:

20.2.1 Power Supply Installations

(1) Traction Substations (TSSs) (at Chandla Dungerwas and Mandothi)

- (1) Incoming Bays for receiving 220 kV double circuit power supply at TSS, the Gantry and Overhead cross feeders including terminations and insulation. Incomer bays with isolators and Circuit Breakers (CB) arrangement.
- (2) Outgoing Bays shall with provision of termination of 220 kV, 3-phase, double circuit power supply, the Gantry and Overhead cross feeders including terminations and insulation. Outgoing bays with motorized isolators and Circuit Breaker (CB) arrangement.
- (3) Metering Bays with Check meters, Metering CT, PT and the associated insulation, protection and Monitoring arrangement.
- (4) 220/132 kV, AC Triple pole Circuit Breakers,
- (5) 220/132 kV – Protection Current Transformers , Potential transformers,
- (6) 220/132 kV, AC, Triple pole Bus Coupler circuit breaker with motorized Isolator;
- (7) 220/132/55 or 2x25kV Traction Transformer(s) complete with all accessories;
- (8) Circuit Breakers suitable for 2x25kV AT feeding System,
- (9) Bridging interrupters suitable for 2x25kV AT feeding system;
- (10) Double pole manual isolators, suitable for 2X25 KV AT feeding system;
- (11) Lightning arrestors for 132 kV, 55kV and 2X25 KV AT feeding system.
- (12) 55/2x25 kV & 25kV Rigid Bus bar arrangement along with required

insulation and isolation.

- (13) 25 kV Bus Coupler CBs. .
- (14) Auto transformers.
- (15) Auxiliary transformers 2 nos. 100kVA for 25kV/240V single phase supply at TSS;
- (16) Single core and multi core copper Conductor, XLPE insulated cables.
- (17) Return current circuit cabling (minimum 3.3kV, single core) and bonding for the tracks, Earthing and Bonding system including Buried Rail for efficient Traction return current;
- (18) Control & Protection system comprising of Protection relays, Control Relay panel and CTs / PTs,
- (19) Batteries and Battery Chargers;
- (20) Power quality improvement equipment.
- (21) Power Factor Improvement Device.
- (22) Automatic Fault locator
- (23) RTU and control equipment
- (24) All civil works and general & yard lighting

(1) Sub Sectioning Posts (SSP) (at Sohna, Dhulawat, Manesar, Badli, Jasaur Kheri)

Sub-Sectioning Posts for 2X25 KV AT systems with following equipment:

1. Double pole circuit breakers for 2X25 AT system with Protection relays as required to automatically isolate fault section/ equipment.
2. Double Pole interrupters for 2X25 AT system;
3. Double pole isolators for 2X25 AT feeding system;
4. 55 kV Auto Transformers;
5. Auxiliary Transformers 10kVA, 25kV/240V, single phase;
6. Single core and multi core Conductor, XLPE insulated cables;
7. Return Current Circuit Cabling;
8. Earthing and bonding system;
9. Batteries and Chargers;
10. Lightning Arrestors;
11. Automatic Fault locator
12. RTU and control equipment
13. All Civil works and general & yard lighting.

(2) Sectioning and Paralleling Posts (SP) (at Prithla, Sultanpur, Badsa, Asaudah, New Harsana Kalan)

Sectioning and Paralleling Post for 2X25 KV AT systems with following equipment:

1. Double pole circuit breakers for 2X25 AT system with Protection relays as required to automatically isolate fault section/ equipment.
 2. Double Pole interrupters for 2X25 AT system;
 3. Double pole isolators, for 2X25 AT system;
 4. 55kV Auto Transformers;
 5. Auxiliary Transformers 10 kVA, 25kV/240V, single phase;
 6. Single core and multi core copper Conductor, XLPE insulated cables;
 7. Return Current Circuit Cabling;
 8. Earthing and bonding system;
 9. Batteries and Chargers;
 10. Lightning Arrestors;
 11. Automatic Fault locator
 12. RTU and control equipments
 13. All civil works and general & yard lighting
- (3) The SP at Sultanpur and Asaudah having following equipment :
1. Single Pole interrupters for 25 kV system;
 2. Single Pole isolators, for 25 kV system;
 3. Auxiliary Transformers 10 kVA, 25kV/240V, single phase;
 4. Single core and multi core copper Conductor, XLPE insulated cables;
 5. Return Current Circuit Cabling;
 6. Earthing and bonding system;
 7. Batteries and Chargers;
 8. Lightning Arrestors;
 9. RTU and control equipments
 10. All civil works and general & yard lighting

20.2.2 Overhead Equipment (OHE)

(1) Flexible polygon type (2x25kV AT Feed) OHE system

The OHE system having following equipment: :

1. 2x25kV AT Feed Overhead Equipment (OHE) on main lines; comprising Traction & Negative Feeders, Catenary & contact wires, ATD, motorized Isolators, overlaps, anchoring arrangement, cantilever, insulators, PTFE neutral section, Section Insulators etc.
2. 1x25 kV system for loop lines and yard lines;
3. 1x25 kV system for the connecting lines to Indian Railways upto IR meeting point at Patli, Sultanpur, Asaudah and Harsana Kalan station. Prithla to New Prithla station of DFCCIL.

4. Aerial Earth Wire (AEW);
5. Buried Earth Conductor (BEC, if required);
6. Protective screen over catenary and NFW at foot over bridges (FOB) at Harsana Kalan station along with warning & danger boards with earthing.
7. Number plates, danger/caution boards, Sigma Boards etc.
8. Earthing system.

(2) Rigid Overhead Conductor System (ROCS)

1. Conductor rail.
2. Support bracket
3. Overlaps and expansion joint
4. Anchoring arrangement
5. Jumpers
6. Cantilever arm
7. Sectioning arrangement
8. Transition element
9. Earthing system
10. AEW support in tunnel
11. NFW support arrangement.

20.2.3 SCADA SYSTEM

SCADA system items are as under:

1. Remote monitoring and control of 220/132 kV TSS supply.
2. Remote monitoring and control of Traction Substations (TSS),
3. Remote monitoring and control of Sectioning Posts (SP),
4. Remote monitoring and control of Sub Sectioning Posts (SSP),
5. Remote monitoring of power supply status of Auxiliary Transformers (ATs).
6. Remote monitoring and control of switching stations (1x25 kV type) of lines joining IR at Patli, Sultanpur and Asaudah. (The RTU etc at Patli SP shall be provided by another contractor). Being boundary posts, the control of these posts at Indian Railways Remote Control Centre is also included in this AMC work.
7. Monitoring of above TSS, Switching posts etc having switches such as Circuit Breakers, Interrupters, motorized Isolators etc,
8. The monitoring includes acquisition of data such as Voltage, Current, kVA, power factor, Maximum demand, Energy etc. with recording facilities and storage of data for a period of 3-Months time.

9. OHE Catenary Indication with auto fault localization and isolation of faulty section with monitoring fault locations as triggered by Fault Locators acting on the algorithm and logics as approved and compatible for reporting to the OCC.
10. Electrical safety and earthing of SCADA equipment which include earthing of equipment, cables and non-current carrying metallic components, etc.
11. Monitoring of check metering at TSS to register all the Energy parameters similar to those measured by Power utilities,

20.2.4 240V Single Phase AC Power Supply

- a) *All 25 kV / 0.240 kV Auxiliary Transformers, their connection to OHE, distribution board near Auxiliary Transformers, LT power cable from Auxiliary Transformers to Auto change over panel & Auto change over panel at all 17 main line stations and Sultanpur station.*
- b) *All 25 kV / 0.240 kV Auxiliary Transformers, their connection to OHE, distribution board near Auxiliary Transformers, LT power cable from Auxiliary Transformers to Auto change over panel & Auto change over panel for Automatic Signalling System power supply from Prithla to New Harsana Kalan section and IR connectivity.*

20.3 Maintenance Schedules and parameters

20.3.1 Maintenance schedules

Contractor shall develop daily, weekly, monthly, six-monthly, and yearly maintenance schedules and also for periodical overhaul. The Maintenance shall be undertaken as guidelines of RDSO, ACTM and Manufacturer’s maintenance manuals. The various maintenance schedule i.e daily, weekly, monthly, quarterly, half yearly, yearly and periodic overhaul etc of all equipment of OHE, ROCS, TSS/SSP/SP and SCADA system along with associated works shall be submitted by Contractor for approval of Engineer. During this period, all material, tool and tackles, consumables and manpower shall be provided by Contractor.

20.3.2 Maintenance and availability parameters

Contractor shall maintain the PSI, OHE/ROCS and SCADA systems to the highest reliability index and shall not be less than:

PSI: Power availability shall be ensured 100% as 100% standby arrangement has been provided (N-1 case failure).

OHE: OHE/ROCS availability shall be 99.5%.

SCADA: Availability of SCADA hardware shall be 99.99% and SCADA Restoration time shall be less than 30 minutes.

20.4 Manpower Requirement:

The minimum requirement of manpower for maintenance shall be as under:

- (4) For OHE

SN	Staff	No.	of	Minimum Qualification	Penalty per
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**Part 2, Section VII-2: Employer's Requirements - Particular Specifications (PS)-for 2x25 kV, AC
Traction electrification and associated works**

	Designation	persons to be deployed		month or part thereof per person in Rs.
1	Sr. Engineer	1	Degree in Electrical Engineering with 5 years experience of similar nature	40,000
2	Field Engineer	1 per shift	Degree in Electrical Engineering with 3 years experience of similar nature OR Diploma in Electrical Engineering with 5 years experience of similar nature	25,000
3	Skilled	5 per shift	Diplomat with 1 year experience of similar nature OR ITI with 3 years experience of similar nature	15,000
4	Semi-skilled	5 per shift	Matriculation	12,000

(5) For PSI (TSS/SP/SSP) and SCADA

SN	Staff Designation	No. of persons to be deployed	Minimum Qualification	Penalty per month or part thereof per person Rs.
1	Sr. Engineer	1	Degree in Electrical Engineering with 5 years experience of similar nature	40,000
2	Field Engineer	1 per shift	Degree in Electrical Engineering with 3 years experience of similar nature OR Diploma in Electrical Engineering with 5 years experience of similar nature	25,000
3	Skilled	5 per shift	Diplomat with 1 year experience of similar nature OR ITI with 3 years experience of similar nature	15,000
4	Semi-skilled	5 per shift	Matriculation	12,000
5	Field Engineer (SCADA)	1 per shift	Degree in Electrical or Electronics or Communications Engineering with 3 years experience of similar nature OR Diploma in Electrical or Electronics or Communications Engineering with 5 years experience of similar nature	25,000

- (6) The above are the minimum manpower which shall be provided all the time and manpower shall be augmented by Contractor as per actual work requirement. Necessary manpower as leave reserve etc shall be kept and manpower as mentioned per shift shall be ensured.
- (7) There shall be maintenance offices at Sohna, Manesar & Khakhoda and Contractor shall depute staff at all these locations suitably in consultation with the Employer. Contractor may depute staff at other locations also as per requirement.

20.5 Maintenance Office and OHE/PSI depot:

- 20.5.1 Contractor shall set-up maintenance office and OHE/PSI Depot, corresponding stores, repair shops, which includes furniture, computers, material racks staff cup-boards, tools & Tackles, instruments, material handling instruments, communication instruments, material consumable etc. For proper upkeep of all the installations at least 2 vehicles shall be kept in OHE/PSI depot. In addition at least one vehicle shall be kept at other maintenance locations.
- 20.5.2 The space for office and OHE/PSI depot (approximately 1000 sqm) shall be provided by Employer, free of cost. Water and Electricity shall be supplied by the Employer free of cost but emergency arrangement shall be made by Contractor, if Employer's water and electricity are not available due to any reason.
- 20.5.3 Contractor shall train and supervise staff under his control and ensure that staff operate and maintain the equipment properly and in particular do actually observe all prescribed rules and regulations, Joint Procedure orders shall be issued for safety precautions, SHE policy to ensure proper safety. Personnel Protective Equipment (PPE) shall invariably be used while working on the system and no staff shall be allowed to work without PPE.
- 20.5.4 Contractor shall ensure that special testing instruments, tool and equipment including the OHE inspection cars (provided and maintained by others) for maintenance of OHE are properly cared for and maintained in in proper condition. The break down vehicles provided by Contractor shall always be in working condition.
- 20.5.5 Contractor shall provide and maintain an emergency road vehicle (with driver) in good working condition all the time and keep all spares and T&P in ready to use condition. In case Emergency road Vehicle is under maintenance, standby arrangements are to be made by Contractor. Emergency Road vehicle shall be of sufficient capacity so that it can carry all T&P and spares including 7 metre Long Aluminum Ladders and with sufficient seating capacity for maintenance gang.

20.6 Material during AMC period

- (6) All the materials, consumables, lubricants, tools & tackles, measuring instruments, transport road vehicle etc or any thing else required during maintenance i.e routine, emergent and break down shall be arranged by the Contractor. All the spares (list given in Chapter 13.2) shall be issued one time by the Employer to contractor for maintenance and restoration of OHE/PSI as per site requirement on recoupment basis. Any Spare item, if consumed by contractor for maintenance/restoration purpose of HORC, shall be recouped with brand new item by contractor within a period of 3 months from date of consumption. The contractor shall keep all the Spares of OHE/PSI in respective Depots at all the times with maximum allowed delay of 3 months which will be in case of recoupment due to unforeseen events. A penalty of amount of two times of the latest market rate of Spare item shall be imposed by Employer on contractor in case of Non compliance of recoupment within 3 months. The contractor shall handover all the Spares (

as per list given in Chapter 13.2) to Employer 6 weeks prior to completion of Maintenance period (with or without extension) in unused condition duly recouped with brand-new Spare items.

- (7) During damage to any infrastructure due accident to a train, the restoration shall be attended by Contractor and all the material cost shall be paid to the contractor by Employer as per cost provisions available in the contract. Any material available with the Employer shall be given to the contractor. All the manpower shall be arranged by the contractor without any cost.
- (8) Tower wagon of Employer shall be used by contractor shall be maintained by Contractor and all the maintenance cost shall be borne by the contractor. All the fuels and lubricants shall be arranged by the contractor. Competent and trained Tower wagon driver shall be employed by contractor at own cost.

20.7 Permit to work

Contractor shall train all the staff regarding permit-to -work system and issue competency certificate to staff with the consent of Employer. The Competent staff shall only undertake OHE/PSI work only after obtaining permission from TPC (Traction Power Controller) to undertake the work.

20.8 Periodical reports to Employer:

Contractor shall submit the periodical returns after careful scrutiny to Employer as under:

- i) Work done during the day
- ii) Failure analysis reports
- iii) Unusual occurrence reports
- iv) Power block and PTW reports
- v) Accidental reports
- vi) Staff position reports

Further reports as desired by Employer shall be submitted by Contractor.

20.9 List of Special Tools and Instrument

Contractor shall keep sufficient tools & tackles and testing & measuring instruments at all times for maintenance of PSI, PHE, ROCS and SCADA system. The indicative list is as under:

S. No	Description	Quantity in No's
1.	Cable Fault Locator	1 sets
2.	AC Power Line Analyzer	2 nos.
3.	Digital earth testers	3 nos.
4.	Earth Leakage Detector 1000 V	3 nos.
5.	Digital Insulation Tester 2.5/ 5 kV	3 nos.
6.	Digital Insulation Tester 0 – 1000 V	3 nos.
7.	Dynamo Meter (5.0 T x 20 Kg)	1 nos.
8.	Vernier Caliper	1 nos.
9.	Walky Talkie Set	6 nos.
10.	Primary injection test kit	1 nos.

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S. No	Description	Quantity in No's
11.	Secondary injection test kit	1 nos.
12.	Relay Testing Kits	1 nos.
13.	Infra-red remote temperature sensor	2 nos.
14.	Fully automatic Oil dielectric test kit with printer	1 nos.
15.	Thermal Imaging Camera capable of being mounted on Tower Wagon /loco Hand held Thermal Imaging camera	2 nos. 2 nos.
16.	Height and Stagger gauge (instrument laser based)	4 sets
17.	Dissolved Gas Analyzer set	1 nos.
18.	Hydraulic Compressor for Aluminum conductor Splicing Zig (all sizes)	1 sets
19.	Turfers all weight categories	10 each type
20.	Pull lift all weight category	10 each type
21.	Come-along clamps for different conductors	20 for each size
22.	Discharge Rod complete including earthing cable and connectors	20 nos.
23.	Aluminum Ladders (5 m and 11 m extendable)	15 each
24.	Portable petrol/ kerosene set 1.5 KVA	5 nos.
25.	Vehicle mounted Oil filtration plant 1 phase 3000 liters per hour capacity	1 nos.
26.	Portable diesel Generating set 3 kVA 230 V.A.C.	2 nos.
27.	150 sq.mm Contact wire Cutter 36"	10 nos.
28.	Wire Cutter 12"	10 nos.
29.	"D" Shackle set (1",3/4", 5/8", &1" One Each)	20 nos.
30.	Single sleeve Pulley Block 3.5" x 5/8" Groove Fiber for drawl of contact. &catenary wire	20 nos.
31.	Portable rail drill machine.	5 nos.
32.	Siren 3 phase Range 5 Km and 1 phase Range 1 Km	2 each
33.	Ladder Trolley capable of running on track	2 nos.
34.	DE and Ring Spanner sets suitable for Fittings being supplied	20 nos.
35.	Chain pulley block all weight category as required for erection	10 nos.
36.	Hydraulic insulator testing jig	2 nos.
37.	Copper Hammer	5 nos.
38.	Nonmetallic Hammer	2 nos.
39.	Micro Meter	5 nos.
40.	Fiber measuring Tape 30 mtr. & 15 mtr. Each	10 nos.
41.	Isolator pad lock	10 nos.
42.	Neutral Section inspection Jig	2 nos.
43.	Nylon rope 20 meters length	10 nos.
44.	Diagnostic kit (LAPTOP) along with software capable of testing all type of modules to identify Faults	3 nos.
45.	Digital Multi-meter	3 nos
46.	Portable operated tree pruner	5 nos

S. No	Description	Quantity in No's
47.	Motorised Earth Augur	2 nos
48.	Crimping Tools for droppers/ conductors (all types)	10 nos
49.	Operating rod for DO fuse (Pull Rod)	5 nos
50.	Inflatable lighting tower	3 nos
51.	Portable Power hacksaw	3 nos
52.	Safety Helmet	50 nos
53.	Safety Harness	10 nos
54.	Hand blower	2 nos
55.	Vehicle mounted Oil filtration plant 1 phase 300 liters per hour capacity	2 nos
56.	Box spanner set	3 nos
57.	Portable Tan Delta & Capacitance Measuring Bridge	2 nos
58.	Capacitance meter	2 nos
59.	Portable grinder Electrically operated	2 nos
60.	Steel sling with eye each end 1 m, 2 m and 3 m	10 each
61.	Steel sling with eye each end 5 m, 10 m	5 each
62.	Twister cum bender 6"	10 nos
63.	33 kV gloves	2 sets
64.	Oliver – G	1 no
65.	Truck for major maintenance and attending breakdown	1 no
66.	Road Vehicles for regular maintenance	3 Nos. (minimum)

The above list is indicative and Contractor shall arrange additional tools & tackles and testing & measuring instruments as per the requirement.

20.10 AMC Contract and penalty:

- (1) Contractor shall sign an agreement with the Employer at least 6 months prior to start of the Defect Notification Period. All terms and conditions including various maintenance schedules shall be incorporated in the agreement.
- (2) On receipt of information of any failure of OHE, PSI, SCADA, the Contractor's staff shall reach the site within 30 (thirty) minutes and attend the failure within 90 (ninety minutes) of receipt of information. If failure is not attended within ninety minutes, a penalty of Rs 10,000/- (Rs ten thousand only) per hour (beyond ninety minutes) shall be levied when train operation is not affected and Rs 50,000/- (Rs fifty thousand only) when train operation is affected. The annual cumulative penalty shall be limited to 10% (ten percent) of the annual AMC price.

(End of Chapter- 20)




Part 2 - Employer's Requirements

Section VII-3: Tender Drawings

Section VII-8: Tender Drawings

Tenderer shall download Tender drawings from HRIDC website. Tender Drawings are available for downloading under Active Tender Section on HRIDC website (<https://hridc.co.in/active-tender.php>). Tender drawings uploaded on HRIDC website for Package SYS-1 shall be deemed to form part of Final Tender Document. List of Tender Drawings are enclosed hereunder.

List of Tender Drawings

	-Black colour shows Tender drawings which have not been revised
	-Blue colour shows Tender drawings which have been revised
	-Red colour shows New additional Tender drawings

A. Electrical Drawings

SN	Description	Drawing No.
1	Indicative General Power Supply Diagram	GC-HRIDC-SYS1-DRW-ELE-001_A1
2	Indicative OHE System for Open Route on Tangent Track	GC-HRIDC-SYS1-DRW-ELE-002_A1
3	Indicative OHE System for Open Route on Curved Track	GC-HRIDC-SYS1-DRW-ELE-003_A1
4	Indicative Typical Arrangement of Portal and Earthing of OHE Structure and Rails	GC-HRIDC-SYS1-DRW-ELE-004_A0
5	Indicative Typical Arrangement of BEC with OHE Structure and Rails	GC-HRIDC-SYS1-DRW-ELE-005_A0
6	Indicative OHE, Earthing & Bonding Arrangement on RCC Bridge/ Viaduct	GC-HRIDC-SYS1-DRW-ELE-006_A0
7	Indicative OHE Guy Rod Arrangement on Steel Bridge/ Viaduct	GC-HRIDC-SYS1-DRW-ELE-007_A0
8	Indicative Typical Sectioning Arrangement of Station	GC-HRIDC-SYS1-DRW-ELE-008_A1
9	Indicative OHE Mast on Girder Bridge with Earthing	GC-HRIDC-SYS1-DRW-ELE-009_A1
10	Indicative Earthing & Bonding of OHE Structure along the Bridge, Girders (RCC) & Piers	GC-HRIDC-SYS1-DRW-ELE-010_A0
11	Indicative 2x25 kV High Rise ROCS in Tunnel	GC-HRIDC-SYS1-DRW-ELE-011_A1
12	Indicative Single Line Diagram of Traction Substation 220/132/2x25kV Scott Connected Transformer	GC-HRIDC-SYS1-DRW-ELE-012_A0
13	Indicative Control Room Building at TSS	GC-HRIDC-SYS1-DRW-ELE-013_A1
14	Indicative Single Line Diagram of Sectioning Post(SP)	GC-HRIDC-SYS1-DRW-ELE-014_A1

15	Indicative Single Line Diagram of Sub-Sectioning Post(SSP)	GC-HRIDC-SYS1-DRW-ELE-015_A1
16	Indicative Control Room Building for SP& SSP	GC-HRIDC-SYS1-DRW-ELE-016_A1
17	Indicative Drawing for TSS/SP/ SSP Fencing	GC-HRIDC-SYS1-DRW-ELE-017_A1
18	Indicative General Arrangement Block Diagram for Traction SCADA Control	GC-HRIDC-SYS1-DRW-ELE-018_A0
19	Indicative General Arrangement Block Diagram for Auxiliary SCADA Control	GC-HRIDC-SYS1-DRW-ELE-019_A0
20	Indicative Plan and Elevation for Tower Wagon Shed	GC-HRIDC-SYS1-DRW-ELE-020_A1
21	Indicative Cable Route Plan for Motorised Isolator	GC-HRIDC-SYS1-DRW-ELE-021_A0
22	Indicative Traction Line Diagram	GC-HRIDC-SYS1-DRW-ELE-022_A0
23	Indicative portal arrangement in Manesar station yard and Manesar – Patli open route	GC-HRIDC-SYS1-DRW-ELE-023_A0

B. Civil Drawings

SN	Description	Drawing No.
1	Conceptual Plan & Longitudinal Section (– 2.12 km to - 0.6 km)	GC-HRIDC-ALL-DRW-ALN-P&P-(-2.12)- (-0.6) KM_A0
2	Conceptual Plan & Longitudinal Section (- 0.6 km to 0 km)	GC-HRIDC-ALL-DRW-ALN-P&P-(-0.6)-0 KM_A0
3	Conceptual Plan & Longitudinal Section (0 km to 5 km)	GC-HRIDC-ALL-DRW-ALN-P&P-0-5 KM_A0
4	Conceptual Plan & Longitudinal Section (5 km to 10 km)	GC-HRIDC-ALL-DRW-ALN-P&P-5-10 KM_A0
5	Conceptual Plan & Longitudinal Section {10 km to 15 km (Tunnel)}	GC-HRIDC-ALL-DRW-ALN-P&P-10-15 KM_A2
6	Conceptual Plan & Longitudinal Section (15 km to 20 km)	GC-HRIDC-ALL-DRW-ALN-P&P-15-20 KM_A2
7	Conceptual Plan & Longitudinal Section (20 km to 25 km)	GC-HRIDC-ALL-DRW-ALN-P&P-20-25 KM_A0
8	Conceptual Plan & Longitudinal Section {24 km to 30 km (Tunnel)}	GC-HRIDC-ALL-DRW-ALN-P&P-24-30 KM_A0
9	Conceptual Plan & Longitudinal Section 29 km to 33 km	GC-HRIDC-ALL-DRW-ALN-P&P-29-33 KM_A1
10	Conceptual Plan & Longitudinal Section (33 km to 35 km)	GC-HRIDC-ALL-DRW-ALN-P&P-33-35 KM_A1
11	Conceptual Plan & Longitudinal Section (35 km to 40 km)	GC-HRIDC-ALL-DRW-ALN-P&P-35-40 KM_A1
12	Conceptual Plan & Longitudinal Section (40 km to 45 km)	GC-HRIDC-ALL-DRW-ALN-P&P-40-45 KM_A1

SN	Description	Drawing No.
13	Conceptual Plan & Longitudinal Section (45 km to 50 km)	GC-HRIDC-ALL-DRW-ALN-P&P-45-50 KM_A1
14	Conceptual Plan & Longitudinal Section (49.7 km to 55.6 km) (Main Line)	HRIDC/PS/LS-1
15	Conceptual Plan & Longitudinal Section (55 km to 61.5 km)	GC-HRIDC-ALL-DRW-ALN-P&P-55-61.5 KM_A1
16	Plan & Longitudinal Section (60 km to 65 km)	AA/2245/AL/DR/P&P/R3
17	Plan & Longitudinal Section (65 km to 70 km)	AA/2245/AL/DR/P&P/R3
18	Plan & Longitudinal Section (70 km to 75 km)	AA/2245/AL/DR/P&P/R3
19	Plan & Longitudinal Section (75 km to 80 km)	AA/2245/AL/DR/P&P/R3
20	Plan & Longitudinal Section (80 km to 85 km)	AA/2245/AL/DR/P&P/R3
21	Plan & Longitudinal Section (85 km to 90 km)	AA/2245/AL/DR/P&P/R3
22	Plan & Longitudinal Section (90 km to 95 km)	AA/2245/AL/DR/P&P/R3
23	Plan & Longitudinal Section (95 km to 100 km)	AA/2245/AL/DR/P&P/R3
24	Plan & Longitudinal Section (100 km to 105 km)	AA/2245/AL/DR/P&P/R3
25	Plan & Longitudinal Section (105 km to 110 km)	AA/2245/AL/DR/P&P/R3
26	Plan & Longitudinal Section (110 km to 115 km)	AA/2245/AL/DR/P&P/R3
27	Plan & Longitudinal Section (115 km to 120 km)	AA/2245/AL/DR/P&P/R3
28	Plan & Longitudinal Section (120 km to 125 km)	AA/2245/AL/DR/P&P/R3
29	Plan & Longitudinal Section (125 km to 126 km)	AA/2245/AL/DR/P&P/R3
30	Detailed Plan and Longitudinal Section from Chainage (0 km to 5.72 km) (Connectivity Line)	HRIDC/PS/LS-2
31	Conceptual Plan & Longitudinal Section Connectivity Towards Patli	GC-HRIDC-C2-DRW-ALN-P&P-03001_A2
32	Conceptual Plan & Longitudinal Section Connectivity Towards Sultanpur	GC-HRIDC-C2-DRW-ALN-P&P-04001_A2
33	Conceptual Plan & Longitudinal Section Connectivity Towards Sultanpur from Badsa	GC-HRIDC-C2-DRW-ALN-P&P-05001_A0

SN	Description	Drawing No.
34	Conceptual Plan & Longitudinal Section Mandothi to Asaudah Connectivity	AA/2245/AL/DR/P&P/R3
35	Re-Grading of Garhi Harsaru-Farukhnagar Main Line of Sultanpur Station Yard (Conceptual)	GC-AA/RLY/2245/HRIDC/ESP-07/REV-03
36	Conceptual Plan Typical Embankment/Cutting Profile	GC-HRIDC-SK-GEN-001_A2
37	Conceptual Engineering Scale Plan of Prithla Junction Yard CH: 00.00m from Prithla	GC-HRIDC-C5-DRW-STN-ESP-PRI01_A0
38	Conceptual Engineering Scale Plan Silani Station Yard CH: 10341.882m from Prithla	GC-HRIDC-C5-DRW-STN-ESP-SIL01_A0
39	Conceptual Engineering Scale Plan of IMT Sohna	GC-HRIDC-C5-DRW-STN-ESP-SOH01_A0
40	Conceptual Engineering Scale Plan of Dhulawat station CH:32767m F/from Prithala	GC-HRIDC-C23-DRW-STN-ESP-DHU01_A1
41	Conceptual Engineering Scale Plan of Chandla Dungerwas Station Yard CH:42606.159m F/Prithala	GC-HRIDC-C23-DRW-STN-ESP-CDU01_A2
42	Conceptual Engineering Scale Plan of Panchgaon Station Yard CH:46279.352m from Prithala	GC-HRIDC-C23-DRW-STN-ESP-PCG01_A2
43	Conceptual Engineering Scale Plan of Manesar Station	GC-HRIDC-C1-DRW-STN-ESP-MAN01_A1
44	Conceptual Engineering Scale Plan of New Patli Junction CH: 58135.513m	GC-HRIDC-C23-DRW-STN-ESP-NPA01_A3
45	Conceptual Engineering Scale Plan of Badsa Junction CH:64742.718m from Prithala	GC-HRIDC-C6-DRW-STN-ESP-BDS01_A0
46	Conceptual Engineering Scale Plan of Deverkhana Station Yard CH: 71098.961m from Prithala	GC-HRIDC-C6-DRW-STN-ESP-DEV01_A0
47	Conceptual Engineering Scale Plan of Badli Crossing Station Yard CH: 76829.080m from Prithala	GC-HRIDC-C6-DRW-STN-ESP-BDL01_A0
48	Conceptual Engineering Scale Plan of Mandothi Station Yard CH: 90449.137m from Prithala	GC-HRIDC-C6-DRW-STN-ESP-MAN01_A0
49	Conceptual Engineering Scale Plan of New Asaudah Station CH:94031.161m from Prithala	GC-HRIDC-C6-DRW-STN-ESP-NAS01_A0
50.	Conceptual Engineering Scale Plan of Jasaur Kheri Station Yard CH 100228.880m from Prithala	GC-HRIDC-C6-DRW-STN-ESP-JSK01_A0

SN	Description	Drawing No.
51	Conceptual Engineering Scale Plan of Kharkhoda Kirholi Station Yard CH: 108728.865m from Prithala	GC-HRIDC-C6-DRW-STN-ESP-KHR01_A0
52	Conceptual Engineering Scale Plan of Tarakpur Crossing Station Yard CH: 114218.885m from Prithala	GC-HRIDC-C6-DRW-STN-ESP-TAR01_A0
53	Conceptual Engineering Scale Plan of New Harsana Kalan Junction CH 125091.992m from Prithala	AA/RLY/2245/HRIDC/ESP-17/REV-5
54	Conceptual Engineering Scale Plan DFC New Prithla yard	GC-HRIDC-C5-DRW-STN-ESP-NPR01_A0
55	ESP of Patli Station	GC-HRIDC-C2-DRW-ALN-ESP-001_A0
56	Conceptual Engineering Scale Plan of Asaudah	GC-HRIDC-C6-DRW-STN-ESP-IRA01_A0
57	Conceptual Engineering Scale Plan of Sultanpur Kaliawas Junction CH 36774.74m from Badsa KM:6/375	GC-HRIDC-C2-DRW-ALN-ESP-003_A0
58	Conceptual Drawing for single track tunnel cross section (ROCK)	GC-HRIDC-C4-DRW-TTL-CLT-01001_A1
59	Conceptual Drawing for single track tunnel cross section (SOIL)	GC-HRIDC-C4-DRW-TTL-CLT-01002_A1
60	Conceptual General Arrangement Drawing for Viaduct BR.NO.70	GC-HRIDC-C5-DRG-BRD-GAD-01070_A0
61	Conceptual plan for location of OHE mast for Composite Girder Bridges	GC-HRIDC-SK-GEN-031
62	Conceptual plan for location of the OHE mast in viaduct	GC-HRIDC-SK-GEN-032
63	General Arrangement Drawing of Proposed Major bridge (RFO) No.277 AT CH : 94381.195m 3x30.5m Open Web Girder (Crossing Railway on Delhi – Rohtak Section)	GC-HRIDC-C6-DRW-BRD-GAD-01277_A0
64	Conceptual Plan of OHE Portal for OWG Girder	GC-HRIDC-SK-GEN-036

Note: Section VII-8:Tender Drawings are available for downloading under Active Tender Section on HRIDC website (<https://hridc.co.in/active-tender.php>).

**Part 2- Section VII-4: Employer's
Requirements
Environment, Social, Health and Safety
Management (ESHS) Manual**

Section VII-4: Employer's Requirements

Environment, Social, Health and Safety Management Manual

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1.0 ESHS FRAMEWORK

1.1 General

- 1.1.1. The Contractor shall be responsible for the Environment, Social, Health and Safety (ESHS) on the Site and any other areas being used by him for the purposes of the Contract. Each Contractor shall develop his own contract specific ESHS Management Plan, which will represent his approach to the management of ESHS activities on his work sites under the Contract with the Employer. The ESHS Management Plan should contain all the measures as given in the project Environmental and Social Management Plan (ESMP) which is part of the project ESIA.
- 1.1.2. The Contractor shall ensure that all appropriate ESHS measures are implemented throughout the execution of the Works.

1.2 Scope

- 1.2.1 The ESHS Manual defines the principal requirement of the Employer and forms an essential part of the overall Environment, Social, Health and Safety Management System proposed to be employed by the Employer for the construction of the Project.

1.3 Application of This Document

- 1.3.1 This document applies to all aspects of the Contractor's Scope of Work including Sub-contractors and all other agencies. There shall be no activity associated to the Contract, which is exempted from the purview of this document.

1.4 Purpose of This Document

- 1.4.1 The objective of these guidelines is to ensure that adequate precautions are taken for incident/occupational illness free safe work execution as well as to avoid harmful effects on the environment and social during construction.
- 1.4.2 This document:
- a) Describes the Environment, Social, Health and Safety interfaces between the Engineer and the Contractor.
 - b) Details the processes by which the Contractor shall manage Environment, Social, Health and Safety issues while carrying out the work under the contract.
- 1.4.3 These requirements shall be read together with, ISO 45001: 2018 Occupational Health and Safety Management System and ISO 14001: 2015 Environmental Management Systems.
- 1.4.4 The Contractor shall be responsible for obeying all Laws, Rules & Regulations in force at any point of time regarding the Environment, Social, Health & Safety of workers.

2.0 ESHS MANAGEMENT

2.1 General

2.1.1 This document defines the principal requirements to be practiced at the Site at all times.

2.2 ESHS Targets and Goals

2.2.1 Following ESHS targets and goals shall be set and achieved by the Contractor/Sub-contractor based on time bound work plan:

- a) Zero total recordable injuries;
- b) Zero non-conformances in respect of statutory laws related to Environment, Health, Social and Welfare measures, living conditions and Safety regulations;
- c) Total compliance of recording and reporting of all types of incidents;
- d) 100% compliance on Safety Induction of all personnel;
- e) Total compliance of conducting inspections and audits as per approved ESHS Management Plan;
- f) 100% incident recording and reporting;
- g) 100% adherence to usage of appropriate PPEs at work;
- h) Executing construction work with least disturbance to the environment, adjoining road users and traffic;
- i) Minimize waste generated at sites and maximize reuse of materials;
- j) Maintaining environment conditions of site as per statutory requirement of HPCB, NGT etc. to avoid penalty;
- k) To achieve construction site as zero discharge site as far as possible.

2.3 Contractor's Obligation to Abide by Mandatory Legislations and Standards

2.3.1 The construction works shall be undertaken in accordance with the Employer's ESHS Management Policy and Management Systems as amended from time to time.

2.3.2 The construction works shall be undertaken in accordance with all updated applicable legislation listed below, but not limiting to:

- a) Indian Electricity Act 2003 and Electricity Rules, 2005;
- b) National Building Code, 2016;
- c) Factories Act, 1948 and state respective factory Rules;
- d) Motor Vehicles Act as amended in 1994 and The Central Motor Vehicles Rules, 1989;
- e) Indian Road Congress Code IRC: SP: 55-2014 'Guidelines on Safety in Road Construction Zones';
- f) The Petroleum Act, 1934 and Rules, 1976;
- g) Gas Cylinder Rules, 2003;
- h) Indian Explosives Act, 1884, along with the Explosives Substance Act, 1908 and the Explosives Rules, 1983;
- i) Environmental and Social Legislations as listed in Clause 6.0 of this document.

2.4 Contractor's Environmental, Social, Health and Safety Management Policy and Plan

2.4.1 The Contractor as per Rule 39 of the BOCW Central Rules shall formulate an Environment,

Social, Health & Safety policy and display it at conspicuous places at work sites in English and Hindi so that the policy shall be understood by majority of the construction workers.

- 2.4.2 The Contractor shall revise the policy whenever any modification having implication on the Environment, Social, Health and Safety of the workers is made or any new construction work, substances, or technique are introduced which have implication on environment, health and safety of workers.
- 2.4.3 The contractor shall submit the ESHS Management plan for review by the engineer within 28 days after the commencement date.
- 2.4.4 The Contractor shall revise and submit the ESHS Management Plan if at any time the ESHS Management Plan is insufficient in the Engineer's opinion. The Contractor, within 7 days of such intimation shall submit the revised ESHS Management Plan to the Engineer for review.
- 2.4.5 Any omissions, inconsistencies, and errors in the ESHS Management Plan or the Engineer's acceptance or rejection of the ESHS Management Plan and/or supplements thereto shall be without prejudice to the Contractor's obligations with respect to site ESHS and shall not be excused for any failure by the Contractor to adopt proper and recognized ESHS practices throughout the execution of the Works. The Contractor shall adhere to the ESHS Management Plan and shall ensure, as far as practically possible, that all supervisors and sub-contractors of all tiers have a copy of the ESHS Management Plan on the Site and comply with its provisions.
- 2.4.6 The details of contents to be covered in the ESHS Management Plans are given in Clause 8.0, Attachment -1[Contents of ESHS Management Plan] of this document.

2.5 Designer's Role

- 2.5.1 The Designer's primary role includes to minimize the risk to Environment, Social, Health and Safety of those who are going to construct, maintain, clean, repair, dismantle or demolish the structures and anyone else like adjoining road users/public, who might be affected by the work.
- 2.5.2 Every temporary structure like scaffold, temporary deck, earth retaining structures etc. shall be properly designed.

2.6 Site ESHS Organisation

- 2.6.1 The Contractor shall appoint the required ESHS Management Personnel as prescribed in the Contract.
- 2.6.2 **Conduct and Competency**

The Contractor shall ensure that all personnel are competent to perform the job assigned to them. In the event that the Contractor is unable to demonstrate the competency of any person whose activities can directly impact the Works' ESHS performance, the Engineer shall remove that person from the Site without any procedural formalities.

2.6.3 Approval from The Engineer

The name, address, educational qualification, work experience of each ESHS personnel deployed shall be submitted to the Engineer for approval well before the start of the Works or before deployment whichever is earlier. These personnel are authorized to work only after the approval of the Engineer. In case any ESHS personnel leaves the Contractor, the same shall be intimated to the Engineer within a week. The Contractor shall recruit new personnel and fill up the vacancy before relieving a person. Proper handing over of all the documents shall be ensured before relieving an ESHS person.

2.7 Responsibility of ESHS Personnel

- 2.7.1 The Contractor ESHS Management Personnel shall report to Contractor's ESHS Expert who shall always report directly to the Contractor's Project Manager. Their primary role is to oversee Environment, Social, Health and Safety aspects at work Site. The Engineer shall always monitor

adherence to this procedure.

- 2.7.2 No Contractor shall engage ESHS manpower from any outsourcing agencies as in that case the effectiveness would be lost. All ESHS manpower shall be on the payroll of the main contractor only and not on the payroll of any sub-contractor or outsourcing manpower agencies etc.

2.8 ESHS Committee

- 2.8.1 After the commencement of actual sitework, the Contractor shall form Site ESHS Committee and the same shall be communicated to the members.

- 2.8.2 The Terms of Reference for the Site ESHS Committees shall be as follows:

- a) To oversee implementation of the Contractor's Environment, Social, Health and Safety policies and practices;
- b) To monitor the adequacy of the Contractor's ESHS Management Plan and ensure its implementation;
- c) To review ESHS training;
- d) To review the Contractor's ESHS monthly reports;
- e) To identify probable causes of accident and unsafe practices in construction work and to suggest remedial measures;
- f) To stimulate interest of the Workers in ESHS by organizing environment/safety week, safety competition, talks and film-shows on environment/safety, preparing posters or taking similar other measures as and when required or as necessary;
- g) To go around the Site with a view to check unsafe practices and detect unsafe conditions and to recommend remedial measures for their rectifications including first-aid medical and welfare facilities;
- h) Committee team members should perform a site inspection before every committee meeting and to monitor ESHS inspection reports;
- i) To bring to the Notice of the Engineer hazards associated with use, handling and maintenance of the equipment used during the course of construction work;
- j) To suggest measures for improving environment, social, health and safety in construction work at the Site;
- k) To investigate the health hazards associated with handling different types of explosives, chemicals, and other construction materials and to suggest remedial measures including personal protective equipment; and
- l) To review the last ESHS committee meeting minutes and the remedial measures taken for Non-Compliance.
- m) Following shall be the composition of the Site ESHS Committee:

- 2.8.3 Site ESHS Committee meeting shall be conducted once in a calendar month and participation of following members shall be ensured.

Chairman	Project Manager
Secretary	ESHS Expert (Will be nominated by Project Manager)

Members	<ul style="list-style-type: none"> i) Contractor's ESHS staff. ii) Labour Welfare Officer; iii) In -charge of Plant and Machinery & Site Electricals; iv) In-charge of Special Work Operations (e.g. bridge, viaduct, and tunnel, etc.); v) In-charge of Stores; vi) Subcontractor's representative; and vii) Workers' representatives;
Engineer's Representatives	To be nominated by the Engineer

2.8.4 **Minimum time between two monthly ESHS Committee meetings**

A minimum period of 21 days shall be maintained between any two ESHS monthly committee meetings.

2.8.5 **Agenda**

The Secretary shall circulate the agenda of the meeting at least seven working days in advance of the scheduled date of the meeting to all members as well as to the Employer.

2.8.6 The agenda should broadly cover the following:

- a) Chairman's overview of ESHS Management Performance;
- b) Confirmation of minutes of last meeting;
- c) Previous month ESHS statistics;
- d) Incident and accident investigation/Dangerous occurrence/Near miss report;
- e) Site ESHS inspection and compliance report;
- f) The Contractors' ESHS issues;
- g) Report from the Employer and Engineer;
- h) Non-compliances raised by Engineer/Statutory Authorities;
- i) Report and compliance of GRC; and
- j) Any other concern.

2.8.7 In case of station and other contiguous areas where more than one main Contractor is working together, the Engineer shall instruct the other Contractors/ Sub-contractors to join for the monthly ESHS committee meeting of the main civil Contractor, to discuss and decide about the common provision of safety, security, lighting, toilet, drinking water etc. and sharing the maintenance cost of the same etc.

2.8.8 The Minutes of the Meeting shall be prepared as per the format provided and sent to all members within 2 working days by mail. Minutes of ESHS Committee Meeting shall also be displayed on the notice board for wider publicity to all concerned.

2.9 **ESHS Induction Training and ID Card**

2.9.1 The Contractor shall ensure that all personnel working at the Site receive an ESHS induction

training immediately on the first day of joining explaining the nature of the work, the hazards that may be encountered during the site work. Personnel shall only be deployed at site once he/she has completed ESHS induction training. The training shall cover the contents as given in Clause 8.0, Attachment-4 [General Instruction: ESHS/GI/001].

2.9.2 All personnel shall be issued a photo identity card as per the format given in Clause 8.0, Attachment-4[General Instruction: ESHS/GI/002].

2.9.3 The Contractor shall also issue a Personnel pocket ESHS Booklet in a language known to the Workers, which provides information on ESHS and emergency procedures.

2.10 Other ESHS Training

2.10.1 The Contractor shall organize the ESHS trainings to managers, supervisors and other personnel in behavioral change and improve ESHS performance.

2.10.2 The Contractor shall provide a training/workshop on ESHS to all its workers/staff/employees/subcontractors of at least 2 days. It shall be completed in various modules and each employee/worker shall have a record of completing all modules.

2.10.3 On-the spot practical skill development training on height safety including scaffold safety, crane safety, welding safety, electrical safety, and traffic safety for marshals shall also be conducted.

2.10.4 Every employee including workman shall take a ESHS oath followed by toolbox talk every day.

2.10.5 All vehicles and machine drivers including heavy work vehicle and machine operators shall be trained on defensive driving with necessary certificate or license.

2.11 ESHS Inspections

2.11.1 The Contractor shall evolve and administer a system of conducting ESHS inspection and other risk management analysis on a periodical basis.

2.11.2 The purpose of ESHS inspection is to identify any deviation in construction activities and operations, machinery, plant and equipment and processes against the ESHS Management Plan and its supplementary procedures and programs.

2.11.3 The Contractor shall initiate a monthly joint site ESHS Management inspection with the Engineer and report shall be generated on the same day with the corrective action and accepted target date (within a week) by the Engineer.

2.11.4 The Contractor project manager & ESHS expert with site team shall be participating in the ESHS inspection.

2.11.5 The Compliance of the joint inspection "Non-Conformance" shall be witnessed/accepted by the Engineer.

2.11.6 The Contractor shall submit follow up compliance report of the ESHS inspection report within six days of the date of Inspection in a coloured soft copy.

2.11.7 Following ESHS inspections program shall be adopted:

- a) Planned general inspection;
- b) Routine inspection;
- c) Specific inspection; and
- d) Other inspection.

2.11.8 **Planned general inspections** are performed at predetermined intervals. Inspections that will be

classified under this inspection program are:

- a) Monthly Contractor and sub-contractor's Site ESHS committee inspection;
- b) Weekly ESHS inspection by construction supervisors (the Contractor and the Subcontractor); and
- c) Daily ESHS inspection by the Contractor Site ESHS team.

2.11.9 **Routine inspections** are often referring to the inspection of the Site, equipment and temporary structures performed by the Site and equipment operators and temporary structure erectors.

Inspections that will be classified under this inspection program are:

- a) Daily inspection of plant and equipment by operators;
- b) Weekly inspection of scaffold by scaffolding supervisors;
- c) Monthly Inspection of electrical hand tools by competent electrical supervisors;
- d) Quarterly inspection of temporary electrical systems by competent electrical supervisors; and
- e) Half-yearly inspection of lifting machinery, lifting appliances, equipment and gears by Govt. approved competent persons.
- f) Quarterly inspection of lifting gears, tools tackles and appliances.
- g) Quarterly colour coding of lifting gears, tools & tackles. The recommended colour coding for the 4 quarters of the years shall be as under
 - i) January – March: GREEN
 - ii) April – June: YELLOW
 - iii) July – September: BLUE
 - iv) October – December: WHITE

2.11.10 The list mentioned above is not exhaustive. The Contractor may add additional categories. The ESHS Expert shall ensure that a system of routine inspections is carried out periodically to all plants, equipment, powered tools and any other temporary structures that will pose a hazard to operators and workmen.

2.11.11 **Specific Inspection**

Specific inspections are performed on activities without a predetermined date. Competent supervisors usually perform inspections for ensuring an activity whether it is executed in accordance to a general set of rules; Method Statement submitted or developed procedures.

The following are examples that will be commonly performed as required on the Site:

- a) Inspection performed before a heavy lifting operation;
- b) Inspection performed before and after the entry of person into a confined space;
- c) Inspection performed before and after a welding and gas cutting operation;
- d) Inspection of formwork before concreting by formwork erector.

2.11.12 The list mentioned above is not exhaustive. The Contractor shall ensure that a competent supervisor inspects all high-risk processes and activities.

2.11.13 **Other inspections** include the following:

- a) Mandatory inspections by Labour Department of Government of Haryana; and
- b) HRIDC/Engineer site ESHS management team.
- c) Inspections by Central Pollution Control Board, Haryana Pollution Control Board, Ministry

of Environment and Forest and Climate Change, National Green Tribunal etc.

- 2.11.14 The Contractor shall prepare all required ESHS inspection checklists for all activity operations and equipment. Checklists will be prepared based on the Indian Safety Standards, Rules and Regulations and the Works requirements.
- 2.11.15 All inspection records and reports will be properly kept and filed for audit purpose. Inspection reports of planned general inspection and routine inspection will be used for discussion during safety committee meetings.

2.12 ESHS Audit

- 2.12.1 The purpose and scope of ESHS Audit is to assess potential risk, liabilities and the degree of compliance of the ESHS Management Plan and its supplementary procedures and programs against applicable and current ESHS legislation regulations and the Works requirements.
- 2.12.2 The Contactor's project manager shall hold the ultimate responsibility in ensuring implementation of ESHS audit program during the construction work.
- 2.12.3 Monthly Audit Rating Score (MARS)
- 2.12.4 Monthly Audit Rating Score (MARS) will be performed once in a month. A team consisting of the Contractor's project manager, ESHS experts and the Engineer's representative based on the pre-designed score-rating format will conduct it.
- 2.12.5 This Monthly ESHS Audit Rating Score (MARS) report will enable the Engineer to evaluate the general compliance by the Contractor with the Conditions of Contract, and the ESHS Management Plan. A Minimum Compliance level to achieve 75% overall Audit Rating is essentially required. Failing this, the Engineer will take punitive action which includes non-processing of running account bills.

2.12.6 Timing

The Monthly Audit Rating Score (MARS) should be conducted at least 7 days prior to the scheduled date of monthly ESHS Committee Meeting.

2.12.7 Evaluation

The numerical scoring has been weighed on a 1-10 scale. The audit team will use their observations noted in evaluating the points to be awarded against each of the elements of the audited section. Wherever some topics and sub-topics are not applicable the score rating need not be given. The overall audit ratings shall be achieved by:

$$\text{Overall Audit rating} = \frac{\text{Actual Score Achieved}}{\text{Maximum Possible Score}} \times 100$$

The criticality of the required actions for the respective sections of the Audit will be classified as:

S.No.	Score	Description	Action
1	< 60%	Immediate	Require the Contractor to rectify within 24 hours
2	< 75%	Improvement Necessary	The Contractor rectification within 7 days and confirmed in writing to the Engineer
3	< 90%	Improvement Desirable	The Contractor rectification within 1 month and confirmed in writing to the Engineer

2.12.8 Report

A copy of each Audit Report will be sent to the Engineer and to all subcontractors, with whom it will then be discussed in detail at the monthly ESHS Committee Meeting to ensure that any corrective actions are agreed upon.

2.12.9 Monthly Electrical Safety Audit

2.12.10 A team comprising of Contractor's Senior ESHS (Electrical) Manager along with the Engineer representatives shall conduct a monthly electrical safety audit covering the following and submit the report to the Engineer. The report shall be submitted in the format as prescribed by the Engineer.

- i) Electrical accidents investigation findings and remedy.
- ii) Adequacy of power generation and power requirements.
- iii) Power distribution and transmission system in place.
- iv) Updated electrical single line diagram showing the current condition of power source and distribution including the IP rated DBs arrangement.
- v) Electrical Protection devices-selection, installation and maintenance.
- vi) Earth or ground connection and earth pit maintenance details.
- vii) Education and training of electrical personnel undertaken.
- viii) Routine electrical inspection details.
- ix) Electrical maintenance system and register
- x) Name plate details of major electrical equipment.
- xi) Classified zones in the Site, if any

2.12.11 External ESHS Audit

External ESHS Audit is to be conducted by external agencies that are competent with ISO qualified auditors with the prior approval of the Engineer.

a) Areas of Competence of Audit Team

- i) The Audit team shall have practical understanding of BOCWA/R statutory requirements on health/medical and welfare of workmen, construction hazards and its prevention and control, traffic management, electrical safety, rigging, safety of construction equipment and environment and social management.
- ii) The Audit team shall have a Team leader and at least one Team member.
- iii) Audit shall be conducted as per the guidelines of ISO, ILO and national standards. Audit report shall also be presented as per the formats given in the standards; and
- iv) External ESHS Audit shall be conducted on a quarterly basis throughout the currency of the Contract.

b) Targets of ESHS Audit

The contents and coverage of the audit shall include the following items:

i) ESHS Management:

- ESHS Organization;
- ESHS Policy and Plan;
- ESHS committee;
- ESHS orientation;

- ESHS training;
- ESHS communication and motivation;
- ESHS submittals to the Employer;
- ESHS promotional and awareness program;
- Incident reporting & investigation;
- Onsite/offsite emergency preparedness plan;
- Hazard identification and risk assessment;
- Implementations of work permit system.

ii) Technical

- Work Method Statement;
- Operational control procedures/ Safe operating procedures;
- Working at height;
- Hand tools and power tools;
- Electrical safety;
- Fire prevention and control;
- Housekeeping;
- Overhead protection;
- Slipping, tripping, cutting, drowning and falling hazards;
- Lifting appliances and gear, tools and tackles;
- Lifting and launching operation;
- Construction plant and machinery;
- Machine and area guarding;
- Material handling;
- Hot work;
- Demolition;
- Excavation and tunnelling;
- Work permit system;
- Traffic management;
- Chemical handling;
- Dangerous and harmful Environments;
- Maintenance matrix of mechanical and electrical machines / equipment;
- Working on or under water;
- Working near or under high tension line;
- Personal protective equipment;
- Visitors at Site;
- Occupational health and welfare measures;
- All statutory forms, returns under various statutes;

- First-aid and medical facilities;
- Welfare measures; and
- Environmental and Social management.

c) Audit Documents

The Contractor shall make the below itemized documents available for review by the Audit team;

- a) ESHS Policy;
- a) ESHS Management Manual;
- b) ESHS Rules and Regulation;
- c) ESHS Organization chart;
- d) Annual ESHS objectives/programs;
- e) Accident/near miss statistics and analysis;
- f) ESHS training program/records for all personnel;
- g) Operating manuals and maintenance manual of all equipment;
- h) Safe worthiness certificates of all lifting appliances and gears;
- i) Medical fitness record for all personnel;
- j) Risk identification, assessment and control details;
- k) Environmental and Social management reports;
- l) Emergency management records including mock drill;
- m) Housekeeping inspection records;
- n) Minutes of ESHS committee meetings;
- o) Calibration and testing records;
- p) Records of previous audits;
- q) ESHS inspection records;
- r) First Aid, medical facilities and other welfares measures;
- s) Maintenance procedure of plant & machinery;
- t) Records of Industrial hygiene surveys (noise, ventilation, and illumination level, airborne and toxic substances, explosive gases).

d) Audit Preparation

- i) Audit team members are required to gather information by observations through interviews and by checks of documentation.
- ii) Audit team shall prepare checklist to cover all parts based on ESHS legislations Rules and Regulations and ESHS Conditions of Contract requirements.
- iii) Audit team members shall verify the facts and findings of leading to the identified gaps and weakness.
- iv) Audit leader has overall responsibility for reaching a conclusion.

e) Reporting

Audit report shall be prepared and directly sent to the Engineer within 7 days of conducting the audit.

f) Report Contents

- a) *Executing Summary* - Based on the finalized checklists as written the findings to the Engineer by the audit team members, the audit leader will compile a concise and accurate summary of observations and findings;
- b) *Introduction* - This will contain basic information regarding the facilities or organization audited, the specific audit dates (inclusion of those for preparation and post-audit activities);
- c) *Principal Positive Findings* - This will contain the summary of positive aspects as observed by the auditors. It will also contain highlights of those issue, which may warrant dissemination as best practice regarding methodology used or achievement;
- d) *Audit Findings* - All audit findings as detailed in the audit checklists shall be grouped together as priority 1 and 2 as detailed below in a separate listing:
 - i. *Priority 1*: Actions to rectify gaps or weakness should generally be implemented within two-weeks' time if risk potential is high or unacceptable; and
 - ii. *Priority 2*: Actions should be generally implemented or rectified with a maximum of 3- 4 weeks, if not rectified would create a likelihood of minor injury or business loss.

g) Conformity Report Action to the Engineer

- a) The auditor shall inspect the Site after 14 days of conducting initial audit for checking the adequacy of implementation of items maintained under priority 1 by the Contractor and shall submit a Conformity/Non-conformity Report to the Engineer within 7 days ;
- b) The auditor shall again inspect after 28 days of conducting initial audit for checking the adequacy of implementation of items mentioned under priority 2 by the Contractor and shall submit a Conformity/Non-conformity Report to the Engineer within 7 days; and
- c) In case of non-conformity of items mentioned by auditor, the Engineer shall take necessary steps including stoppage of work and suggestion for corrective action to the Contractor.

2.13 ESHS Communication

- 2.13.1 The Contractor shall make every effort to communicate the ESHS Management measures through posters campaigns/billboards/banners/glow signs being displayed around the Site as part of the effort to raise ESHS awareness amongst the work force. Posters should be in Hindi, English and other suitable language deemed appropriate. Posters/billboards/ banners/glow signs should be changed at least once in a month to maintain the impact.
- 2.13.2 The Contractor shall also observe important days as listed in Clause 8.0, Attachment-4 [General Instruction: ESHS/GI/003] and printing and displaying ESHS signage and posters as listed in Clause 8.0, Attachment-4 [General Instruction: ESHS/GI/004].

2.14 ESHS Submittals

- 2.14.1 The Contractor's ESHS Management shall send the following reports to the Engineer periodically in soft copy:
 - a) Daily reporting of total number of workmen;
 - b) Monthly ESHS Report;
 - c) Minutes of ESHS Committee meeting;
 - d) ESHS inspection and compliance reports; and

- e) ESHS audits reports;
 - Monthly Audit Rating Score (MARS) reports;
 - Monthly Electrical Safety Audit;
 - External ESHS audits;

2.14.2 The Contractor shall prepare a Monthly ESHS Report consisting of the following within 7th of next month to the Engineer:

- a) Monthly man-hour details as specified in the ESHS Management Plan;
- b) Monthly accident/incident details as specified in the ESHS Management Plan;
- c) ESHS committee details;
- d) ESHS inspection and compliance report;
- e) ESHS internal audit details;
- f) ESHS communication activities undertaken in the month indicating the number of posters displayed and balance availability in stock;
- g) Monthly Environment (including air, noise, water and soil testing results) and Social Report;
- h) Graphical representation of monitored results over past four reporting periods;
- i) Details of Clearance/ Permission//Permit obtained;
- j) Compliance status for conditions of all relevant clearances /permissions / consents/permits for the Work, including quarries, etc.;
- k) Tree felling, transplanting and compensatory planation details;
- l) Details of consumption of construction material, energy and water;
- m) Details of different types of waste and scrap generated during the month and sold to authorised recyclers;
- n) Summary of complaints, results of investigations and follow-up actions;
- o) Gender: Number of female workers, percentage of female workforce, gender issue raised and dealt with;
- p) HIV/AIDS: Provider of health services, information& training;
- q) GBV/SEA: Details of training conducted;
- r) Grievances: List of grievances received in the reporting period and unresolved past grievances by date received, complaint how received, to whom referred to for action, resolution and date (if completed), date of resolution of community grievances if any.
- s) Toolbox talks details;
- t) PPE details: Quantity purchased, issued to the workmen and stock available;
- u) Details on IP 44 panel boards, lighting poles, welding and cutting equipment, Ladders, Hoists, Tools & Tackles;
- v) Monthly lux meter study results;
- w) Housekeeping;
- x) Barricade maintenance details;
- y) No of critical excavations;
- z) Health and welfare activities;

- aa) ESHS activities planned for next month.

2.15 Accident Reporting and Investigation

- 2.15.1 All accidents and dangerous occurrences shall immediately be informed through message to the Engineer. This will enable the Engineer to reach the scene of accident/dangerous occurrences to monitor/assist any rescue work and/or start conducting the investigation process so that the evidences are not lost.
- 2.15.2 Reports of all accidents (fatal/injury) and dangerous occurrences shall also be sent to the Engineer within 24 hours by the Contractor.
- 2.15.3 In addition to the above verbal and written reporting to the Engineer, as per Rule 276 of HBOCWR, notice of any accident to a worker at the Site that:
- a) Causes loss of life; or;
 - b) Disables a worker from working for a period of 48 hours or more immediately following the accident; shall forthwith be sent by telegram, telephone, fax, or similar other means including special messenger within 4 hours in case of fatal accidents and 72 hours in case of other accidents, to:
 - i) The Assistant Director, Industrial Safety and Health having jurisdiction in the area in which the establishment in which such accident or dangerous occurrence took place is located. The Assistant Director, Industrial Safety and Health shall be the authority appointed under section 39 of the Act;
 - ii) Board with which the building worker involved in accident was registered as a beneficiary;
 - iii) Chief inspector; and
 - iv) The next of kin or other relative of the Worker involved in the accident.
- 2.15.4 Further, notice of any accident shall be sent in respect of an accident which:
- a) Causes loss of life; or;
 - b) Disables the injured worker from work (for a period of more than 10 days) to:
 - i) The Officer-in-charge of the nearest police station;
 - ii) The District Magistrate or, if the District Magistrate by order so desires to;
 - iii) The Sub-Divisional Magistrate.
- 2.15.5 In case of an accident-causing minor injury, first-aid shall be administered, and the injured worker shall be immediately transferred to a hospital or other place for medical treatment.
- 2.15.6 Where any accident-causing disablement that subsequently results in death, notice in writing of such death, shall be sent to the authorities within 72 hours of such death.
- 2.15.7 The following items are defined as dangerous occurrences and shall be reported to the inspector having jurisdiction, whether any disablement or death caused to the Worker, namely:
- a) Collapse or failure of lifting appliances, or hoist, or conveyors, or similar equipment for handling of building or construction material or breakage or failure of rope, chain or loose gears; or overturning of cranes used in construction work;
 - b) Falling of heavy objects from height;
 - c) Collapse or subsidence of soil, tunnel, pipelines, any wall, floor, roof or any other part of any structure, launching girder, platform, staging, scaffolding or means of access including formwork;
 - d) Fire and explosion causing damage to any place on the site where the Workers are

employed;

2.15.8 In case of failure of launching girder, lifting appliance, loose gear, hoist machinery and transport equipment at the site, such appliances, gear, hoist, machinery or equipment and the site of such occurrence shall, as far as practicable, be kept undisturbed until inspected by the Inspector having jurisdiction.

2.15.9 Every notice given for fatal accidents or dangerous occurrences shall be followed by a written report to the concerned Authorities under Section 39 of BOCWA and the Chief Inspector of Government of Haryana in the specified Form **XLVI** of the **HBOCWR**.

2.15.10 Actions to be taken post incident/accident:

- a) In case any incident/accident happens at site leading to injury to the worker, the worker/s is/are required to be taken to the nearest hospital immediately;
- b) Project Manager/ESHS Manager/Labour Welfare Officer of the Contractor needs to report the incident to the Engineer immediately without fail for all the death cases including natural deaths;
- c) In case of fatal accident, doctor from the nominated hospital is the only authorized person to declare the death of the worker. It is not to be decided suo-moto by any other person. FIR should be registered for all the fatal cases which happen at the Site/labour camp;
- d) Post Mortem of the dead body is mandatory in all the death cases i.e. whether it is natural or due to any incident / accident;
- e) Family members of the injured / deceased worker are to be informed immediately;
- f) In case of fatal accident, the dead body is to be handed over to the family members. Arrangement of sending the dead body to the native place shall be made by the contractor including cash payment for meeting out last rites expenses as per Rules;
- g) Fatal accident report is to be sent to State Labour Authority in Form EE (as per workmen's compensations act) within seven days and to the Licensing Authority in Form XLVI within 24 hours of the incident/accident;
- h) Copy of all the documents deposited with any labour authority, FIR, Post Mortem, Medical Reports etc. shall be submitted to the Engineer in duly approved Labour Welfare Fund (LWF) Form;
- i) The Contractor shall be liable for getting disbursement of Provident Fund benefits, compensation under Employee compensation Act, benefits of ESI Act to the workman/dependents of the deceased workman. The Contractor shall also provide accommodation and transportation to dependents of the deceased workman or to the disabled workman who come for settlement of terminal claims.

2.15.11 **Accident Investigation:**

- a) Investigations shall be conducted in an open and positive atmosphere that encourages the witnesses to talk freely. The primary objective is to ascertain the facts with a view to prevent future and possibly more serious occurrences;
- b) Accidents and dangerous occurrences which result in death, serious injury or serious damage must be investigated by the Contractor immediately to find out the cause of the accident/occurrence so that measures can be formulated to prevent any recurrence; and
- c) Near misses and minor accidents should also be investigated by the Contractor as soon as possible as they are signals that there are inadequacies in the ESHS Management System.

2.15.12 Procedure of Incident Investigation

It is important after any accident or dangerous occurrence that information relating to the incident

is gathered in an organized way. The following steps shall be followed:

- a) Take photographs and make sketches;
- b) Examine involved equipment, work piece or material and the environmental conditions;
- c) Interview the injured, eye-witnesses and other involved parties;
- d) Consult expert opinion where necessary; and
- e) Identify the specific Contractor or subcontractor involved.

2.15.13 Having gathered information, it is then necessary to make an analysis of incident:

- a) Establish the chain of events leading to the accident or incident;
- b) Find out at what stage the accident took place;
- c) Considering all possible causes and the interaction of different factors that led up to the accident and identify the most probable cause, the cause of an accident should never be classified as carelessness; and
- d) The specific act or omission that caused the accident must be identified.

2.15.14 The next stage is to proceed with the follow-up action:

- a) Report on the findings and conclusions;
- b) Formulate preventive measures to avoid recurrence; and
- c) Publicize the findings and the remedial actions taken.

2.15.15 The Engineer's Independent Incident Investigation

In case of fatal/dangerous occurrence, the Engineer shall also conduct independent investigation. The Contractor and his staff shall extend necessary co-operation and testify about the accident.

2.15.16 The Contractor shall take every effort to preserve the scene of accident till the Engineer completes the investigation.

2.15.17 All persons summoned by the Engineer in connection to witness recording shall obey the instructions without delay. Any wilful suppression of information by any person shall be removed from the site immediately and/or punished.

2.16 Emergency Preparedness Plan

2.16.1 The Contractor shall prepare, as required under BOCWR, an Emergency Response Plan for the Site as a part of the Contractor ESHS Management Plan. The plan shall integrate the emergency response plans of the Contractor and all other Subcontractors. The Emergency Response Plan shall detail the Contractor's procedures, including detailed communication arrangements, for dealing with all emergencies that could affect the Site. The plan shall address items such as injury, sickness, evacuation, fire, chemical spillage, severe weather and rescue.

2.16.2 The Contractor shall ensure that the Emergency Response Plan is prepared to deal with emergencies arising out of, but not limited to:

- a) Fire and explosion;
- b) Collapse of lifting appliances and transport equipment.
- c) Collapse of building, sheds or structure etc.
- d) Landslides getting workers buried, floods, earthquake, storms and other natural calamities etc.

The above list is not exhaustive and other emergencies can also be included.

2.16.3 Arrangement shall be made for emergency medical treatment and evacuation of the victim in the

event of an accident or dangerous incident occurring, the chain of command and the responsible persons of the Contractor with their telephone numbers and addresses for quick communication shall be adequately publicized and conspicuously displayed in the workplace.

- 2.16.4 The Contractor shall require to tie-up with the hospitals and fire stations located in the neighborhood for attending to the casualties promptly and emergency vehicle kept on standby duty during the working hours for the purpose.
- 2.16.5 The Contractor shall conduct an onsite emergency mock drill once in every quarter for all his workers and his sub-Contractor's workers.
- 2.16.6 It shall be the responsibility of the Contractor to keep the Local Law and other Authorities informed and seek urgent help to mitigate the consequences of an emergency. Prompt communication to the Employer and Engineer, through telephonically initially and followed by a written report, shall be made by the Contractor.

2.17 Experts/Agencies for Environment, Social, Health & Safety Services

- 2.17.1 The Contractors may utilise the services of experts/agencies empanelled for the purpose of training, audit and any other ESHS services with prior approval of the Engineer. This approval can be withdrawn by the Engineer at any time if the quality of output of the agency is found not satisfactory.

3.0 LABOUR PROTECTION

3.1 General

3.1.1 The Contractor shall comply in full of the project Workplace Policy as described in Clause-8.0 Attachment-2 [Workplace Policy on HIV/AIDS, Prevention & Control] and Clause-8.0 Attachment -3 [Covid 19 policy].

3.2 Engagement of Staff and Labour

3.2.1 The Contractor shall ensure that the employees deployed by him in the premises of the Employer are physically and mentally fit and do not have any criminal record.

3.3 Payment of Minimum Wages

3.3.1 The Contractor shall ensure payment of at least the minimum wages as prescribed and applicable from time to time under the Minimum Wages Act, 1948 in the presence of an authorised representative of the Engineer and shall maintain proper records of their timely disbursement. These records shall be preserved for a period of at least 3 years and made available even after the Contract is over for any verification by the statutory authorities.

3.4 Conditions of Labour

3.4.1 The Contractor shall observe conditions of labour that are no less favourable than those established for the relevant trade or industry.

3.4.2 During the work, the Contractor shall afford all employees all basic rights enumerated in the conventions of the International Labour Organisation, including freedom of association, right to freedom from forced labour, and right to freedom from discrimination based on race, colour, sex, religion, political opinion and social origin.

3.4.3 The Contractor shall ensure coverage of his employees under the Employees Provident Fund and Miscellaneous Provisions Act, 1952 and the Employees State Insurance Act, 1948 via independent code numbers allotted to them by the Central Provident Fund Organisation and Employees State Insurance Corporation respectively.

3.4.4 The Contractor shall insure all his employees under Group Personal Accident Insurance scheme through a recognised and registered insurance company.

3.5 Labour Laws

3.5.1 The Contractor shall ensure that all his employees and the Subcontractors obey applicable following laws and regulations, including those concerning safety at work.

- a) Minimum Wages Act, 1948;
- b) Payment of Wages Act, 1936;
- c) Equal Remuneration Act, 1976;
- d) Employees Provident Fund and Miscellaneous Provisions Act, 1952;
- e) Employees State Insurance Act, 1948;
- f) Maternity Benefit Act, 1951;
- g) Child Labour (Prohibition and Regulation) Act, 1986;
- h) Building and Other Construction Workers (Regulation of Employment of Service) Act, 1996;
- i) Haryana Building and Other Construction Workers (Regulation of Employment and

Conditions of Service) Rules, 2005;

- j) Building and Other Construction Workers Welfare Cess Act, 1996;
- k) Building and Other Construction Workers Welfare Cess Rules, 1998;
- l) Haryana Major Accident, Hazard Control Rules, 2009; and
- m) Workmen's Compensation Act. 1923;

3.5.2 The Contractor shall comply with all other statutory requirements, rules, regulations and notifications in relation to employment of his staff and workers that may be issued from time to time by the concerned government authorities.

3.6 Working Hours

3.6.1 No work shall be carried out beyond the statutory limit given under BOCWA, 1996.

3.6.2 No work shall be carried out outside the normal working hours stated in the Contract unless otherwise:

- a) The Engineer gives his consent in writing for additional work; and
- b) The work is unavoidable or necessary for the protection of life or property or for the safety of the Works, in which case the Contractor shall immediately inform the Engineer.

4.0 SAFETY GENERAL

4.1 General

4.1.1 The following standards whichever is more stringent shall be applicable:

- a) The BOCW Acts 1996 and the Haryana BOCW Rules 2005 framed there under;
- b) Other relevant National Legislations & IS Codes.

4.2 Housekeeping

4.2.1 General Housekeeping shall be carried out by the Contractor and ensured always at the Site, Construction Depot, Batching Plant, Labour Camp, Stores, Offices and Toilets/Urinals.

4.2.2 Full height fence, barriers, barricades etc. shall be erected around the Site to prevent the surrounding from excavated soil, rubbish etc., which may cause inconvenience to and endanger the public. The barricade especially those exposed to public shall be aesthetically maintained by regular cleaning and painting as directed by the Engineer. These shall be maintained in one line and level.

4.2.3 All surplus earth and debris are removed/disposed of from the working areas to officially designated dumpsites. Trucks carrying sand, earth and any pulverized materials etc. to avoid dust or odour impact shall be covered while moving. The tyres of the trucks leaving the site shall be cleaned with water, wherever the possibility of spillage on carriageways meant for regular road traffic exists

4.2.4 No parking of trucks/trolleys, cranes and trailers etc. shall be allowed on roads, which may obstruct the traffic movement.

4.2.5 Roads shall be kept clear and materials like pipes, steel, sand, boulders, concrete, chips and brick etc. shall not be allowed on the roads to obstruct free movement of road traffic

4.2.6 Proper and safe stacking of material are of paramount importance at yards, stores and such locations where material would be unloaded for future use. The storage area shall be well laid out with easy access and material stored/stacked in an orderly and safe manner. Lumber with protruding nails shall be bent/removed and properly stacked.

4.2.7 Drip pans of suitable size shall be used to collect oil leakages and spills while plants/equipment/machinery maintenance.

4.2.8 The Contractor shall make available Material Supply Data sheet (MSDS) for material/chemicals/substances used at Site. Such material/chemicals/substances used shall be treated, handled, stored, transported and disposed off, by the Contractor, in a manner specified in the MSDS

4.3 Working at Height

4.3.1 Working at height means work in any place, including a place at or below ground level.

4.3.2 The Contractor shall ensure that work at height is properly planned, appropriately supervised, and carried out in a safe manner and without any appreciable risk. Appropriate care shall be taken during bad weather.

4.3.3 Adequate protection in the form of working platform with railing, toe board, safe access, safety net, roof ladder etc. shall be provided. Where fall hazards cannot be eliminated, use fall-arrest systems while erecting, modifying, and dismantling scaffolds.

- 4.3.4 A trained and certified person shall check working platform, railing, toe board, safe access, safety net, roof ladder etc. after erection and once in a week. A certificate shall be tagged on this equipment.
- 4.3.5 Employees involved in the erection, dismantling, moving, repairing, etc., of scaffolding and also workers who perform work on a scaffold shall receive training from a competent person. The purpose of the training is to recognize any hazards associated with the work.
- 4.3.6 When the height of a scaffold exceeds three times of the smallest width of the base, secure it to the building or structure at every other lift and every 9.0 m horizontally. The scaffold and scaffold working platform with handrails approximately 1.0 m high, mid rails, and toe boards, all secured rigidly by both ties and braces to prevent movement. Working platforms should be completely decked with safety planks, manufactured scaffold decking, or metallic planks.
- 4.3.7 Only metal frame working scaffold is permitted. Steel stairs are used as a means of raising and lowering the metal frame working scaffold, except for special cases. It is prohibited to directly raise and lower the framework with limbs or to use only ladder.
- 4.3.8 The Contractor shall ensure that following areas are clearly indicated:
- where a workplace contains an area in which, owing to the nature of the work, there is a risk of any person at work;
 - Falling a distance; or
 - Being struck by a falling object:
- 4.3.9 The Contractor shall ensure that work equipment exposed to conditions causing deterioration, which is liable to result in dangerous situations, is inspected at suitable intervals and after any exception occurrence jeopardizing the safety of work/equipment.
- 4.3.10 In relation to work at height involved in construction work;
- The top guard-rail or other similar means of protection shall be at least 1100 mm above the edge from which any person is liable to fall;
 - Toe-boards shall be suitable and sufficient to prevent the fall of any person, or any material or object, from any place of work; and
 - Any intermediate guardrail or similar means of protection shall be positioned so that any gap between it and other means of protection does not exceed 550 mm.
- 4.3.11 Requirements for all Working Platforms:
- Every working platform requires a firm & stable supporting structure for holding it;
 - A working platform shall possess a suitable surface and be so constructed that the surface of the working platform has no gap through which a person/material/object could fall;
 - A working platform and any supporting structure shall not be loaded to give rise to a risk of collapse or to any deformation, which could affect its safe use;
 - When altered or modified, it should be so altered or modified as to ensure that it remains stable;
 - A working platform shall be of sufficient dimension to permit the safe passage of persons and the safe use of any plant or materials required to be used and to provide a safe working area having regard to the work being carried out there;
 - Depending on the complexity of the scaffolding selected, a responsible person shall draw up an assembly, use and dismantling plan;
 - A copy of the plan, including any instructions it may contain, shall be kept available for the use of persons concerned in the assembly, use, dismantling or alteration of scaffolding until

it has been dismantled; and

- h) While a scaffold is not available for use, including during its assembly, dismantling or alteration, it shall be marked with general warning signs in accordance with and be suitably delineated by physical means preventing access to the danger zone.

4.3.12 Requirements for collective safeguards for arresting falls:

- a) Collective safeguard is a safety net, airbag or other collective safeguard for arresting falls;
- b) A safeguard shall be used only if:
 - i) A risk assessment has demonstrated that the work activity can (so far as is reasonably practicable) be performed safely while using it and without affecting its effectiveness;
 - ii) The use of other safer work equipment is not reasonably practicable; and
 - iii) A sufficient number of available persons have received adequate training specific to the safeguard, including rescue procedures.

4.3.13 Requirements for personal fall protection systems:

- a) A personal fall protection system shall be used only if a risk assessment has demonstrated that:
 - i) The work can (so far as be reasonably practicable) be performed safely while using that system; and
 - ii) The use of other safer work equipment is not reasonably practicable.
The user and a sufficient number of available persons have received adequate training specific to the operations envisaged, including rescue procedures; and
- b) A personal fall protection system designed for use with an anchor shall be securely attached to at least one anchor, and each anchor and the means of attachment thereto shall be suitable and of sufficient strength and stability to supporting any foreseeable loading.

4.3.14 Requirements for Ladders:

- a) Every Contractor shall ensure that a ladder is used for work at height only if a risk assessment has demonstrated that the use of more suitable work equipment is not justified because of the low risk;
 - i) The short duration of use;
 - ii) Existing features on the Site, which he cannot alter;
- b) Only metal ladders shall be allowed. Bamboo ladders are prohibited;
- c) Any surface upon which a ladder rests shall be stable, firm, of sufficient strength and of suitable composition safely to support the ladder so that its rungs or steps remain horizontal, and any loading intended to be placed on it;
- d) A ladder shall be so positioned as to ensure its stability during use;
- e) A suspended ladder shall be attached in a secure manner and so that, with the exception of a flexible ladder, it can not be displaced and swinging is prevented.
- f) A portable ladder shall be prevented from slipping during use by:
 - i). Securing the stiles at or near their upper or lower ends;
 - ii). An effective anti-slip or other effective stability devices; or
 - iii). Any other arrangement of equivalent effectiveness.
- g) A ladder used for access shall be long enough to protrude sufficiently above the place of landing to which it provides access, unless other measures have been taken to ensure a firm

handhold.

- h) No interlocking or extension ladder shall be used unless its sections are prevented from moving relative to each other while in use;
- i) Where a ladder or run of ladders raises a vertical distance of 9.0 m or more above its base, there shall, where reasonably practicable, be provided at suitable intervals sufficient safe landing areas or rest platforms;

4.4 Overhead Protection

4.4.1 The Contractors shall provide overhead protections as per BOCW Act & Haryana BOCW Rules.

4.5 Slipping, Tripping, Cutting, and Falling Hazards

- a) The Contractor shall follow guideline of Slipping, Tripping, Cutting and falling hazards as Per Rule 98 of HBOCWR.
- b) Sharp projections or any protruding nails or similar objects shall be suitably guarded or shall even be avoided to make the place safe to work and All places should be free from dust, debris or similar materials;
- c) Suitable safety net shall be provided at places of material / man falling is possible in accordance with national standards.
- d) Reinforcement of pier/columns/walls/abutments shall be secured from the risk of tilting through provisioning of minimum four guy wires ropes/ steel bracing anchored to any concrete block/counterweight of sufficient capacity.
- e) The Collapse of formwork in the construction industry has the potential for severe injury and death. The four stages of the use of formwork (erection, adjustment, concrete placement and dismantling) all need to be managed in a risk assessment framework. Implementing suitable control measures can eliminate or reduce the potential for events such as the collapse of formwork. Suitable control measures include:
 - i). Keeping the documentation for the formwork at the workplace;
 - ii). Follow the schematic drawing for erection of formwork;
 - iii). Erecting the formwork on foundations which will support the loads to be imposed on the formwork;
 - iv). Not erecting formwork near excavation;
 - v). Ensuring materials used in the erection of formwork are not defective;
 - vi). Securing loose material which may be dislodged as a result of inclement weather;
 - vii). Inspecting the formwork assembly before and during the placement of concrete;
 - viii). Not attaching equipment to the formwork assembly unless specifically designed for this purpose; and not using a stripping process which may cause damage to the permanent structure.

4.6 Lifting Appliances including Cranes

4.6.1 Lifting appliances means a crane, hoist hydra, derrick, winch, gin pole, sheer legs, jack, hoist drum, slewing machinery, slewing bearing fasteners, lifting machinery sheaves, pulley blocks, hooks or other equipment used for lifting materials, objects or the Workers and lifting gears means ropes, chain slings, shackles, hooks, lifting lugs, wire ropes, lifting eyebolts and eye nuts and other accessories of a lifting appliance.

4.6.2 Each of the lifting appliances and lifting gear including all parts thereof, whether fixed or moveable shall be thoroughly tested and examined by a competent person once at least in every 6 months or after it has undergone any alterations or repairs liable to affect its strength or stability. Within

- the validity, if the lifting appliances are shifted to a new site, re-examination by the competent person for ensuring its safety shall also be done.
- 4.6.3 The Contractors shall utilize the services of any competent person as defined in Factories Act, 1948 with the permission of the Engineer.
- 4.6.4 No machine shall be selected to do any lifting on a specific job until its size and characteristics are considered adequate:
- a) The weights, dimensions and lift radii of the heaviest and largest loads;
 - b) The maximum lift height, the maximum lift radius and the weight of the loads that must be handled at each;
 - c) The number and frequency of lifts to be made;
 - d) How long the crane will be required on site;
 - e) The type of lifting to be done (for example, is precision placement of loads important);
 - f) The type of carrier required (this depends on ground conditions and machine capacity In its operating quadrants: capacity is normally greatest over the rear, less over the side, and non-existent over the front);
 - g) Whether loads will have to be walked or carried;
 - h) Whether loads will have to be suspended for lengthy periods;
 - i) The site conditions, including the ground where the machine will be set up, access roads and ramps it must travel, space for erection and any obstacles that might impede access or operation.
- 4.6.5 The Contractor shall ensure that a valid certificate of fitness issued is available for all lifting appliances including synchronized mobile jacks, pre-stressing hydraulic jacks, jacks fitted with launching girders etc. and the Engineer approval is obtained before inducting to the site. Only after obtaining the approval from the Engineer any lifting appliances and gear shall be used.
- 4.6.6 The laminated photocopies of fitness certificate issued by competent person, the Engineers approval letter, the operators photo, manufactures load chart and competency certificate shall always be either kept in the operator cabin or pasted on the visible surface of the lifting appliances.
- 4.6.7 All lifting appliances and loose gears shall be clearly marked for its safe working load and identification by stamping or other suitable means.
- 4.6.8 The Contractor shall also maintain a register containing a system of identification of all tools and tackles, its date of purchase, safe working load, competent person date of examination etc.
- 4.6.9 Sufficient lighting arrangement shall be ensured at all lifting operations.
- 4.6.10 **Qualification of operator of lifting appliances etc.:** The Contractor shall not employ any person to drive or operate a lifting machine-like crane, hydra etc. whether driven by mechanical power or otherwise or to give signals to work as an operator of a rigger or derricks unless he:
- a) Is above 21 years of age and possesses a valid heavy transport vehicle driving license as per Motor Vehicle Act and Rules;
 - b) Is competent and reliable;
 - c) Possesses the knowledge of the inherent risks involved in the operation of lifting appliances by undergoing a formal training at any institution of national importance acceptable to the Engineer; and
 - d) Is medically examined periodically as specified in schedule VII of BOCW Rules.
- 4.6.11 All hydraulic piping and fittings shall be maintained leak proof.

- 4.6.12 Only four legged slings shall be allowed which includes master link (ring), intermediate master link (ring) if necessary, chain / wire rope sling, sling hook or other terminal fitting.
- 4.6.13 Hand spliced slings up to 32mm diameter shall not be used at site for any lifting purpose. The slings used shall conform to IS 2762: 2009 Wire rope slings and sling leg specification.
- 4.6.14 No load shall be slewed over public areas without stopping the road traffic first.
- 4.6.15 Automatic safe load indicator (ASLI) to be provided in crane with audible and visible warning system and made functional and calibrated by the manufacturer or its authorized representative every 6 months or after repair of the lifting equipment.
- 4.6.16 **Automatic safe load indicators and data logger in lifting appliances**
As stipulated in Rule 123 of HBOCW Rules, every lifting appliances and gears like cranes, hydras etc., if so constructed that the safe working load may be varied by raising or lowering of the jib or otherwise, shall be attached with an automatic indicator of safe working loads approved by Bureau of Indian standards/International certifying bodies which gives a warning to the operator whenever the load being handled exceeds the safe working limit.
- Provision of functional data logger with alert facility through SMS and web in all cranes shall be mandatory;
 - Cut-out shall be provided which automatically arrests the movements of the lifting parts of every crane if the load exceeds the safe working limit.
- 4.6.17 The crane should have a substantial/durable safe working load chart which has clearly legible characters in English and Hindi and figures displayed inside the crane and is easily visible to the crane operator.
- 4.6.18 **General Requirements**
The sweep area (work area) of the construction machinery shall be always free from obstructions. All hydraulic piping and fittings shall be maintained leak proof. The operator cab shall possess good and safe:
- Structure, windows and windshield wipers;
 - Drivers chair and footrest;
 - Control handles;
 - Cab instrumentation;
 - Telecommunication;
 - Cab outfitting;
 - Wind indicator with an adjustable set point shall be in a position representative for the wind on the crane. The indicator shall give continuous information regarding constant speeds and gusts.
- 4.6.19 **Mandatory Rigging requirement**
- Rigging shall be done under experienced and qualified rigger only. All Load shall be adequately and safely rigged to prevent any danger;
 - The primary requirement in rigging shall be to assess the weight of load before attempting any lift;
 - All hooks shall be fitted with Master Rings having certificate of fitness from the competent person, so that the hooks are subjected to balanced vertical loading only;
 - Only four legged slings shall be allowed which includes master link (ring), intermediate master link (ring) if necessary, chain / wire rope sling, sling hook or other terminal fitting;

- e) Requirements of outriggers
 - i) All outriggers shall be fully extended and all tyres are clear of the ground;
 - ii) Heavy duty blocking having large bearing area shall be necessary to prevent sinking of floats;
 - iii) Provision of heavy steel plates/ high density interconnected wooden logs of required dimension shall be used to uniformly distribute the load;
 - iv) The crane shall be setup on fully compacted ground;

4.6.20 Pick & carry operation

Prohibition on Use of "Tractor transmission type Pick and Carry Hydra Crane": Tractor transmission type Pick and Carry-1st Generation model is prohibited at HORC Project works. Contractor shall mobilize "Truck transmission type" Pick and Carry (Hydra) Crane— minimum 2nd Generation model only or higher model.

4.6.21 Operation of lifting appliances

Every Contractor shall ensure that:

- a) The complete lifting operation shall be governed by signals as per established standards;
- b) Adequate measures to be taken to ensure that no workers is allowed to stand, pass, rides or sit under the suspended load;
- c) No lifting appliances shall be left by the operator while power is on or load is suspended;
- d) After completion of the lifting operation, all doors of the appliances shall be closed by the operator and ignition/operation key should be handed over to competent reliever operator or site In-charge;
- e) All loads are provided with minimum two tag lines to ensure that the load can be controlled at all times;
- f) No close working to any live over head power line is permitted without system of a 'Permit to Work' and prior permission of the engineer shall be obtained before performing such operation;
- g) Danger zone shall be identified and cordoned off for all lifting appliances during their operation;
- h) All lifting gears & slings shall be stamped or appropriate tags for their identification no & SWL;
- i) Knotting/wrapping of chains & slings shall not be allowed at site;
- j) Lifting appliances shall not be used for any dragging or pulling purposes. Contract shall refer to 75% capacity load chart for ascertaining the suitability of crane for safe lifting of load;
- k) During tandem lift, available capacity of crane in respect of SWL shall be considered after reduction of 15% for 75% (DIN) load chart respectively. In addition, additional de rating as advised by third party testing and certified agency shall also apply;
- l) During hoisting of long material, use of suitable lifting beam is recommended;
- m) Only original equipment manufacturer (OEM) supplied/provided load chart shall be used during lifting operation;
- n) Before performing any lifting operation, all electronic devices, control levers, hydraulic oil, wind pressure etc. shall be checked and necessary spare parts to be kept in stock to handle any breakdown during time bound lifting operation;
- o) Lifting point shall be considered on the I-Girders/U Girder/C Girder/Steel girder/parapet etc.

during the casting of the same. Design load calculation for the same should be conducted;

- p) All lifting activities shall be stopped in case of high speed wind and similar adverse weather condition or as prescribed by the crane manufacturer; and
- q) All cranes shall be provided with fail safe devices to avoid any hoist free fall in case of brake failure.

4.7 Launching Operation

4.7.1 As launching operation is one of the riskiest jobs, the Contractor shall take utmost precaution at all stages like; planning, establishing casing yard, casting segments, transporting segments, fabrication and erection of launching girders, launching of segments, pre-stressing, auto launching of girders and dismantling of launching girders.

4.7.2 The Contractor shall prepare a comprehensive Method Statement for the launching operation, adhering to the ESHS conditions laid down in conditions of contract on the ESHS Management Manual. Reference shall be made to the provisions on working at height. As the entire process of launching must be undertaken at an elevated level the safety of workers and the girder is paramount important. In addition to general precautions, such as trained personnel, PPE, etc. listed in earlier clauses, the following general guidelines shall be adhered to throughout the launching operation:

- a) The segments shall rigidly secure to the truck with necessary wooden wedges and necessary red indicators/safety tapes provided so that the vehicle is clearly seen by other road users both in day/night time;
- b) Every launching operation shall have a responsible engineer on duty all the time;
- c) All the time from erection to dismantling the area between the two piers wherein launching is in progress shall always be barricaded;
- d) Auto launching shall be done only after approval from the Engineer. After every auto launching the stability of launching girder shall be ensured;
- e) The vertical deflection of launching girder shall be monitored at all critical stages like with/without loads and after every auto launching;
- f) A register containing all important operational details from erection to dismantling of launching girders shall be maintained and made available to the Engineer whenever called for;
- g) Driver shall also have undergone proper medical examination as per sub-Clause-5.2 (Medical Facilities) and checked for influence of alcohol before any kind of lifting operation;
- h) Test certificate for all lifting gears including Macalloy Bars shall be maintained at a
- i) location closer to the launching girder itself so that it can be referred during all inspections;
- j) Proper & safe access stairways shall be maintained for safe ascending /descending of workmen /engineers to or from launchers;
- k) Adequate collective and personnel fall protection measures like provision of safety nets while working over live roads/railways, lifeline for anchoring of safety harness, safe means of access on main box girder shall be ensured;
- l) Before starting of the launching, valid third party test certificate of the launcher hoist shall be available;
- m) Safe and fully deck working platform duly covered from all side shall be ensured for stressing work at front support;
- n) Safety checklist for all activities of launching cycle shall be prepared, got approved & implemented;

4.8 Construction Machinery

- 4.8.1 Construction machineries may include dumpers and dump trucks, lift trucks and telescopic handlers, piling rigs, vibration hammers, rail welding equipment, mobile elevating work platforms, cranes, tipper lorries, lorry loaders, skip wagons, 360° excavators, 180° backhoe loaders, crawler tractors, scrapers, graders, loading shovels, trenchers, side booms, pavers, planers, chippers, road rollers, locomotives, tankers and bowsers, trailers, hydraulic and mechanical breakers etc.
- 4.8.2 Every construction equipment shall be in sound mechanical working condition and certified by either competent person under Factories Act or manufacturers' warranty in case of brand new equipment or authorized persons/firms approved by the Engineer before induction to any site.
- 4.8.3 Fitness of the machine shall be carried out on regular basis or after every maintenance work excluding any minor service/oil or filter change and be documented properly. The certificate shall be available in operator/driver cabin.
- 4.8.4 All vehicles shall be fitted with audible reverse alarms and maintained in good working condition. Reversing shall be done only when there is adequate rear-view visibility or under the directions of a banksman.
- 4.8.5 **General operating procedures:** Drivers entering site shall be instructed to follow the safe system of work adopted on site. These shall be verbal instructions or, preferably, written instructions showing the relevant site rules, the site layout, delivery areas, speed limits, etc.
- a) No passengers shall be carried, unless specific seating has been provided in accordance with the manufacturer's recommendations;
 - b) Working on gradients beyond any equipment's capability shall not be allowed.
 - c) Prevention of dumper and dump truck accidents should be managed by providing for adequate lateral clearances, wheel stops at a sufficient distance from the edges of excavations, spoil heaps, pits, markers, etc.;
 - d) No construction material, other than soil shall be carried in excavator buckets;
 - e) When two or more scrapers are working on the same job, a minimum distance of at least 25m shall be kept between them;
 - f) Every contractor shall ensure that Competency certificate for driver/operator shall be issued by their Plant and Machinery In-charge. The certificate shall be pasted on the machine body in such a way that drivers/operator vision is not hindered;
 - g) Checklist shall be prepared for all construction machinery and be filled on daily basis by the operator and be counter signed by plant & machinery person;
 - h) Provision of helper is mandatory for each construction appliances and vehicles during their movement inside and outside of site; and
 - i) All wood working machines shall be fitted with suitable guards and devices such as a stop guard, riving knife, push stick, guards for drive belts and chains, and emergency stop switch easily accessible by the operator.

4.9 Machine Guarding

- 4.9.1 The Contractor shall ensure at the site all motors, cog wheels, chains and friction gearing, fly wheels, shafting, dangerous and moving parts of machinery are securely fenced or legged.
- 4.9.2 Fencing of dangerous parts of machinery shall not be removed while the machinery is in use or in motion and when removed, it shall be replaced as soon as practicable and in any case before the machinery is again brought into use.

4.10 Site Electricity

- 4.10.1 The Contractor shall refer to the applicable guideline "Indian Electricity Rules, 1956" and any

amendment thereafter. ESHS requirements are:

- a) Graduate Electrical Engineer having Electrical Supervisory Competency Certificate.
- b) Diploma Electrical Engineer having Electrical Supervisory Competency Certificate;
- c) ITI Certificate Holder Electrician with Wiremen Permit; and
- d) Assessment of Electrical Load and properly designed power distribution system;

4.10.2 The Indian Electricity Rules 1956 and Indian Electricity Act 2003 as amended up to date shall be followed. The detailed instructions on safety procedures given in Indian Standards, Indian Electricity Rules and respective State Electricity Authorities' Regulation with up to date amendment shall be applicable.

4.10.3 **Assessment of Power**

- a) The contractor shall assess the size and location of the electrical loads and the manner in which they vary with time during the currency of the contract.
- b) The contractor shall elaborate as to how the total supply is to be obtained/generated. The details of the source of electricity, earthing requirement, substation/panel boards, distribution system shall be prepared and necessary approval from the Engineer obtained before proceeding of the execution of the job.
- c) The main contractor shall take consideration, the requirements of the Subcontractors' electric power supply and arrive at the capacity of main source of power supply from diesel generators. All the norms on installation and maintenance have to be adhered.
- d) As small capacity generators create more noise and safety hazards, no small capacity diesel generators shall be allowed for whatsoever the type of job to be executed under this contract.
- e) Usage of Transformers inside the tunnel is strictly prohibited.

4.10.4 **Work on Site**

- a) The contractor shall also submit electrical single line diagram, schematic diagram and the details of the equipment for all temporary electrical installation and these diagrams together with the temporary electrical equipment shall be submitted to the Engineer for necessary approval.
- b) The LT/HT distribution diagrams of sub stations shall be prominently displayed. The substation premises, main switch rooms and D.B enclosure shall be kept clean whenever works are carried out either inside or outside.
- c) No flammable material shall be stored in places other than the rooms specially constructed for this purpose in accordance with the provisions of Indian Explosives Act.
- d) Protective and Safety equipment such as rubber gauntlets or gloves, earthing rods, linemen's belt, portable artificial respiration apparatus, safety goggles etc., shall be provided as per the requirements of the work.
- e) Necessary number of caution boards such as "Man working on line, Don't switch on" shall be readily available in the vicinity of electrical installation.
- f) Charts displaying methods of giving artificial respiration to a recipient of electrical shock (one in English and another one in the regional language) shall be prominently displayed at appropriate places.
- g) No work shall be undertaken on live installations or on installation, which could be energized unless another person is present to immediately isolate the electrical supply in case of any accident and to render first aid, if necessary.
- h) No work on live L.T bus bar or pedestal switch board in the sub stations should be handled by a person below the rank of a licensed wireman and such a work should preferably be

done in the presence of a qualified engineer.

- i) When working on or near live installations, suitable insulated tool should be used and special care should be taken to see that those tools accidentally do not drop on live terminals causing shock or dead short.
- j) The electrical switch controls in distribution boards shall be clearly marked to indicate the areas being controlled by them.
- k) Before starting any work on the existing installation, it shall be ensured that the electric supply to that portion is cut off. Precautions, like displaying "Men at Work" caution boards on the controlling switches, removing fuse carrier from these switches shall be taken against accidental operation. Caution boards shall be kept with the person working on the installation.
- l) All equipment/ sub systems shall conform to relevant IEC standard on Electromagnetic Compatibility (EMC)
- m) The Contractor shall provide adequate stand by equipment to ensure the safety of personnel, the works and the public.

4.10.5 No electrical equipment shall be put into use where its strength and capability may be exceeded in such a way as may give rise to danger.

4.10.6 **Adverse or Hazardous Environments:**

4.10.6.1 Electrical equipment which may reasonably foreseeably be exposed to-

- a) Mechanical damage.
- b) The effects of the weather, natural hazards, temperature or pressure;
- c) The effect of wet, dirty, dusty, or corrosive conditions; or
- d) Any flammable or explosive substance, including dust, vapors, or gases, shall be of such construction or a necessary protected as to prevent, so far as is reasonably practicable, danger arising from such exposure.
- e) In all the above situations, only appropriate IP-rated electrical panels, plugs, sockets etc. shall be used.

4.10.7 **Distribution System:**

- a) The contractor shall provide a distribution system for control and distribution of electricity from a main AC supply of 50Hz for typical appliances.
 - i) Fixed plant – 400 V 3 phase
 - ii) Movable plant fed via trailing cable over 3.75 kW – 400 3 phases.
 - iii) Installation in Site buildings – 230V single phase.
 - iv) Fixed flood lighting – 230 V single phase
 - v) Portable and hand tools- 115V single phase
 - vi) Site lighting – 115V single phase
 - vii) Portable hand lamps – 115V single phase

4.10.8 **Electrical Protection circuits**

- a) Appropriate electrical protection shall be provided for all circuits, against overload, short circuit and earth fault current.
- b) The Contractor shall provide sufficient ELCBs (maintain sensitivity 30 mA)/ Residual Current Circuit Breakers (RCCBs) for all the equipment (including Potable equipment),

electrical switchboards, distribution panels etc. to prevent electrical shocks to the Workers.

- c) All protection devices shall be capable of interrupting the circuit without damage to any equipment's and circuits in case of any fault may occur. No single insulation cable shall be used.
- d) Rating of fuses and circuit breakers used for the protection of circuits should be coordinated with equipment power ratings.
- e) Protection against lightning shall be ensured through lightening arrester for equipment's kept in open at Sites.
- f) The contractor shall ensure that all generators and welding sets in use on Site are adequately and effectively always earthed during operation.

4.10.9 Cables:

- a) Cables shall be selected after full consideration of the condition to which they shall be exposed and the duties for which they are required. Supply cable up to 3.3kV shall be in accordance with BS 6346:1997;
- b) For supplies to mobile or transportable equipment where operating of the equipment subjects the cable to flexing, the cable shall conform to any of these codes BS 6007/BS 6500/BS 7375.
- c) Flexible cords with a conductor cross section area smaller than 1.5 mm² shall not be used and insulated flexible cable shall conform to BS 6500 and BS 7375.
- d) Where low voltage cables are to be used, reference shall be made to BS 7375. The following standards shall also be referred to particularly for underground cables BS 6346 and BS 6708.
- e) Cables buried directly in the ground shall be of a type incorporating armour or metal sheath or both. Such cables shall be marked by cable covers or suitable marking tape and be buried at a sufficient depth to avoid their being damaged by any disturbance of the ground. Cable routes shall be marked on the plans kept in the Site electrical register.
- f) Cable passing under the walkway and across way for transport and mobile equipment shall be laid in ducts at a minimum depth of 0.6 meters.
- g) Cables that need to cross open areas, or where span of 3m or more are involved, a catenary wire on poles or other supports shall be provide for convenient means of suspension. The minimum height shall be 6m above ground.
- h) Cables carrying a voltage to earth in excess of 65V other than supply for welding process shall have metal armour or sheath, which has been effectively earthed and monitored by the contractor. In the case of flexible and trailing cables such earthed metal sheath and/or armour should be in addition to the earth core in the cable and should not be used as the protective conductor.
- i) Armoured cables having an over-sheath of polyvinyl chloride (PVC) or an oil resisting and flame-retardant compound shall be used whenever there is a risk of mechanical damage occurring.
- j) Electrical cable of five cores shall be used in all three-phase equipment.

4.10.10 Plugs, socket-outlets, and couplers:

- a) The contractor shall ensure plugs, socket-outlets, and couplers are available in the construction Site as splash proof type. The minimum degree of ingress protection should be of IP44 and IP65 (in Tunnels and in continuous exposures water areas) in accordance with BS EN 60529.
- b) Only plugs and fittings of the weatherproof type shall be used, and they should be colour coded in accordance with the Internationally recognized standards for example as detailed as follows:

- i) 110 volts: Yellow.
- ii) 240 volts: Blue.
- iii) 415 volts: Red.

4.10.11 Connections:

- a) Every joint and connection in a system shall be mechanically and electrically suitable for use to prevent danger. Proper cable connectors as per national/international standards shall only be used to connect cables.
- b) No loose connections or tapped joints shall be allowed anywhere in the Sites.

4.10.12 Potable and hand-held equipment:

- a) The contractor shall ensure the use of double-insulated or all-insulated portable electrical hand equipment.

4.10.13 Other equipment:

- a) All equipment shall have a provision for major switch/cut-off switch in the equipment itself.
- b) All non-current carrying metal parts of electrical equipment shall be earthed through insulated cable.
- c) Isolate exposed high-voltage (over 415 Volts) equipment, such as transformer banks, open switches, and similar equipment with exposed energized parts and prevent unauthorized access.
- d) Approved perimeter marking shall be used to isolate restricted areas from designated work areas and entryways and shall be erected before work begins and maintained for the entire duration of work. Approved perimeter marking shall be installed with either red barrier tape printed with the words "DANGER-HIGH VOLTAGE" or a barrier of yellow or orange synthetic rope, approximately 1 to 1.5 meter above the floor or work surface.
- e) All temporary metal structures like barricade boards, temporary metal containers/shed etc. shall be adequately earthed through suitable means.
- f) All earth pits shall be properly numbered along with display of resistance value and inspection records of the same shall be maintained.

4.10.14 Work on or near live conductors

No person shall be engaged in any work activity on or so near any live conductor (other than one suitably covered with insulating material so as to prevent danger) that danger may arise unless-

- a) It is unreasonable in all the circumstances for it to be dead; and
- b) It is reasonable in all the circumstances for him to be at work on or near it while it is live; and
- c) Suitable precautions (including where necessary the provision of suitable protective equipment) are taken to prevent injury.

4.10.15 Whenever pilling work is undertaken manually through tripod in the influence zone of live OHE, method statement shall be prepared, submitted, and got approved before start of work.

4.10.16 Inspection and Maintenance

- a) All electrical equipment should be permanently numbered, and a record kept of the date of issue, date of last inspection and recommended inspection period.
- b) Fixed installations shall be inspected at least at three monthly intervals; routine maintenance being carried out in accordance with equipment manufactures recommendations.

c) All Electrical panels/DG panels/Distribution boxes etc. shall be provided with rubbers mats.

4.10.17 25KV AC 50Hz single phase Traction:

a) Induction effect of 25 KV AC 50 Hz single phase Traction

- i) The attention of all staff is drawn to the fact that under 25kv ac 50 Hz single phase traction, there is heavy induction on all metallic structures and conductors in the vicinity of the track. The induction is two- fold.
 - Electro- static, which results from the high potential of 25 kv on the OHE system.
 - Electro- magnetic, which is proportional to the currents passing from the sub- station to the OHE to the locomotives/EMUs and back partly through the earth.
- ii) The voltage induced is quite appreciable on overhead conductors running parallel to the tracks depending on the length of parallelism. This explains why most of the overhead telecommunication's lines are replaced by underground cables. Special protective measures are required to reduce the adverse effects of induction.
- iii) In a railway yard, voltage of the order of 200 volts may be induced on yard lighting mains situated 8 m away from the center of a double-line track, of it runs parallel to the 25 KV lines for a distance of about 270 m; it could be several thousand volts when parallelism is much longer. In such a case, a dangerous voltage due to induction will exist even after the power supply to the line has been switched off. No one should therefore attempt to work on any overhead line running alongside the electrified tracks without taking special precautions of earthing on both sides of the work. Before a section is electrified, the necessary modifications to distribution lines in all stations and yards should be carried out, so as to limit the induced voltage within permissible values, but this by no means limits the need for earthing the lines on both the sides of the working party. Earthing should be done individually by each working party as close to the work spot as possible. The distance between the two earths shall not exceed 1 km.
- iv) Such inductive effects occur on large metallic structures such as fencing and structural steelwork of platforms running parallel to the track. They will therefore have to be earthed suitably to afford safety.
- v) Inductive effects also show themselves on any metallic conductor, such as metallic clothes-lines, power lines and lines belonging to private parties running parallel and close to the electrified tracks. Wide publicity should be given to the effects of induction so that special precautions are taken by the private parties.

b) General Safety Precautions while working in OHE Area

The precautions laid down below must be followed under all circumstances in sections equipped for 25 kv as single phase, 50 Hz traction.

- i) No work close to the live OHE shall be carried out without power block unless the work area is properly screened, barricaded, earthed and supervised by a competent Engineer subject to specific approval from Engineer/Employer.
- ii) No work shall be done above or within a distance of 2 m from the live OHE without a "permit-to-work."
- iii) No part of a tree shall be nearer than 4 m from the nearest live conductor. Any tree or branches likely to fall on live conductor should be cut or trimmed periodically to maintain this clearance. Cutting or trimming should be done by the OHE staff themselves or through an agency managed and supervised by them.
- iv) Work for trimming of trees should also be done in the presence of authorized OHE staff or supervisor to maintain the safe clearance of 4 m any dispute regarding cutting of trees may be done on contract basis or departmentally of the terms & conditions of

concerning dept.

- v) No fallen wire or wires shall be touched unless power is switched off and the wire or wires suitably earthed. In case the wires drop at a level crossing, the Gatekeeper shall immediately make arrangements to stop all road traffic and keep the public away.
 - vi) As far as possible closed wagons shall be used for material trains. In case open or hopper wagons are used, loading and unloading of such wagons in electrified tracks shall be done under the supervision of an Engineering official, who shall personally ensure that no tool or any part of the body of the worker comes within the 'danger zone' i.e., within 2 m of the OHE.
 - vii) Permanent way staff should keep clear of the tracks and avoid contact with the rails either when approaching or reaching the work-spot when an electrically hauled train is within 250m.
 - viii) When unloading rails alongside the tracks, it should be ensured that rails do not touch each other to form a continuous metallic mass of length greater than 300m.
- c) Safety precautions on Electrified Sections (Chapter-IV), Electrical Accidents (Chapter-V), Fire precautions (Chapter-VI) of Indian Railways AC Traction Manual Volume – 1, as applicable may be followed.
 - d) While working near the OHE area, as a minimum the safety guidelines as specified in para 20301,20327, 20334, 20335, 20529, 20612, 20614, 20714, 20825, 20833, 21206 and 21207 of Volume II, Part 1 of AC Traction Manual of Indian Railways shall be followed.
 - e) The Training and Competency Certificates (Chapter XII) of Volume-II, Part-I of Indian Railways AC Traction Manual may be followed.
 - f) Power Blocks and permit to work are required to be taken in case of construction work going on in the vicinity of electrified line as per applicable Para of Chapter – VI of Volume-II, Part- I of Indian Railways AC Traction.

4.10.18 **Hand Tools and Power Tools**

- a) The contractor is wholly responsible for the safe condition of tools and equipment used by his employees and that of his subcontractors.
- b) Use of short/damaged hand tools shall be avoided, and the contractor shall ensure all his hand tools used at his work Site are safe to work with or stored and shall also train his employees (including his sub-contractors) for proper use thereby.
- c) All hand tools and power tools shall be duly inspected before use for safe operation.
- d) All hand tools and power tools shall have sufficient grip and the design specification on par with national/international standards on anthropometrics.

4.10.19 **Hand tools:** Hand tools shall include saws, chisels, axes and hatches, hammers, hand planes, screw drivers, crow bars, nail pullers.

4.10.20 The contractor shall ensure that;

- a) For crosscutting of hardwood, saws with larger teeth points (no. of points per inch) shall be preferred to avoid the saw jumping out of the job.
- b) Mushroom headed chisels shall not be used in the worksite where the fragments of the head may cause injury.
- c) Unless hatchet has a striking face, it shall be used as a hammer.
- d) Only knives of retractable blades shall be used in the worksite.
- e) No screwdrivers shall be used for scraping, chiseling of punching holes.

- f) A pilot hole shall always be driven before driving a screw.
- g) Wherever necessary, usage of proper PPEs shall be used by his employees.

4.10.21 Power tools

Power tools include drills, planes, routers, saws, jackhammers, rinders, sprayers, chipping hammers, air nozzels and drills.

4.10.22 The contractor shall ensure that

- a) Electric tools are properly grounded or/and double insulated.
- b) Ground fault Circuit interrupters (GFCIs)/ Residual Circuit Breakers (RCCBs) shall be used with all portable electric tools operated especially outdoors or in wet condition.
- c) When operating in confined spaces or for prolonged periods, hearing protection shall be required.
- d) The tool is held firmly, and the material is properly secured before turning on the tool.
- e) All drills shall have suitable attachments respective of the operations and powerful for ease of operation.
- f) When any work/operation needs to be performed repeatedly or continuously, tools specifically designed for that work shall be used. The same applicable to detachable tool bit also.
- g) Size of the drill shall be determined by the maximum opening of the chuck in case of drill bit.
- h) Attachments such as speed-reducing screwdrivers and buffers shall be provided to prevent fatigue and undue muscle strain to his workers.
- i) Stock should be clamped or otherwise secured firmly to prevent it from moving.
- j) Workers shall never stand on the top of the ladder to drill holes in walls/ceilings, which can be hazardous, instead standing on the fourth or fifth rung shall be recommended.
- k) Electric planes shall not be operated with loose clothing or long scarf or open jacket.
- l) Safety guards used on right angle head or vertical portable grinders must cover a minimum of 180^o of the wheel and the spindle/wheel specifications shall be checked.
- m) All power tools/hand tools shall have guards at their nip points.
- n) Low profile safety chain shall be used in case of wood working machines and the saw shall run at high rpm when cutting and also correct chain tension shall be ensured to avoid 'kickback'.
- o) Leather aprons and gloves shall be used as an additional personal protection auxiliary to withstand kickback.
- p) Push sticks shall be provided and properly used to hold the job down on the table while the heels move the stock forward and thus prevent kickbacks.
- q) Air pressure is set at a suitable level for air actuated tool or equipment being used. Before changing or adjusting pneumatic tools, air pressure shall be turned off.
- r) Only trained employees shall use explosive actuated tools and the tool shall also be unloaded when not in use.
- s) Usage of such explosive actuated tools shall be avoided in the case of places where explosive/ flammable vapours or gases may be present.
- t) Explosive actuated tools and their explosives shall be stored separately and be taken out and loaded only before the time of immediate use.

- u) Misfired cartridges of explosive actuated tools must be placed in a container of water and be removed safely from the project.
- v) No worker shall point any power operated/hand tool to any other person especially during loading/unloading.

4.11 Illumination

- 4.11.1 The Contractor shall provide sufficient site lighting, of the right type and at the right place for it to be properly effective as per the relevant national standards & guidelines.

4.12 Welding and Cutting

- 4.12.1 Gas cylinders in use shall be kept upright on a custom-built stand or trolley fitted with a bracket to accommodate the hoses and equipment or otherwise secured. The metal cap shall be kept in place to protect the valve when the cylinder is not connected for use.
- 4.12.2 Test Certificate for cylinders and Vendor license shall be obtained. The Gas Cylinder Act & Rules shall always be followed at the workplace.
- 4.12.3 All gas cylinders shall be fixed with pressure regulator and dial gauges. clamp or clip shall be used to connect hoses firmly in both sides of cylinders and torches.
- 4.12.4 Non-return valve and flashback arrester shall be fixed at both end of cylinder and torch.
- 4.12.5 Domestic LPG cylinders shall not be used for gas welding and cutting purposes.
- 4.12.6 Dry Chemical Pressure (DCP) or CO₂ type Fire Extinguisher not less than 5 kg shall be fixed at or near to welding process zone in an easily accessible location. Fire extinguisher should confirm to IS 2190:1992.
- 4.12.7 Oxygen cylinders and flammable gas cylinders shall be stored separately, at least 6.6 m (20 feet) apart or separated by a fireproof, 1.5 m (5 feet) high partition. Flammable substances shall not be stored within 15m of cylinder storage areas.
- 4.12.8 Welding grounds and returns should be securely attached to the work by cable lugs, by clamps in the case of stranded conductors, or by bolts for strip conductors. The ground cable will not be attached to equipment or existing installations or apparatus.
- 4.12.9 All electrical installations shall meet the IS: 5571: 1997 and NFPA 70 for gas cylinder storage area and other hazardous areas.
- 4.12.10 Use firewatchers if there is a possibility of ignition unobserved by the operator (e.g. on the other side of bulkheads).
- 4.12.11 The transformer used for electrical arc welding shall be fixed with ammeter and voltmeter and fixed with separate main power switch.
- 4.12.12 Use a low voltage open circuit relay device if welding with alternating current in constricted or damp places.
- 4.12.13 The current for Electric arc welding shall not exceed 300 A on a hand welding operation.

4.13 Excavation General

- 4.13.1 References:
- a) The Haryana Building and other construction workers (Regulation of Employment of conditions of Service) Rules, 2005;
 - b) IS: 3764 -1992 (Re-affirmed 1996): Code of Safety for Excavation Work;
 - c) IS: 4756 -1978 (Reaffirmed 1996): Safety Code for Tunnelling Work;
 - d) IS 4081:2013 Blasting and related drilling operations-code of safety.

4.13.2 The Contractor shall ensure:

- a) Where any construction & building worker engaged in excavation is exposed to hazard of falling or sliding material or article from any bank or side of such excavation which is more than 1.5 m above his footing, such worker shall be protected by adequate piling and bracing against such bank or side.
- b) Undercutting during excavation shall be avoided. Whenever it is inescapable and banks of an excavation are undercut, adequate shoring is provided to support the material or article overhanging such bank;
- c) Excavated material is not stored at least 0.65 m from the edge of an open excavation or trench and banks of such excavation or trench are stripped of loose rocks and the banks of such excavation or trench are stripped of loose rocks and other materials which may slide, roll or fall upon a construction building worker working below such bank;
- d) Metal ladders and staircases or ramps are provided, as the case may be, for safe access to and egress from excavation where, the depth of such excavation exceeds 1.5 m and such ladders, staircases or ramps comply with the IS 3696 Part 1&2 and other relevant national standards;
- e) Trench and excavation is protected "against falling on a person by suitable measures if the depth of such trench or excavation exceeds 1.5m and such protection is an improved protection in accordance with the design and drawing of a professional engineer, where such depth exceeds 4.0m;
- f) Full height fence, barriers etc. will be installed at the site in order to preserve the surrounding area from excavated soil, rubbish etc. which may cause inconvenience to the public.

4.13.3 Warning Signs and Notices:

The Contractor shall ensure that suitable warning signs or notices, required for the safety of workers carrying out the work of an excavation, shall be displayed or erected at conspicuous places in Hindi and in a language understood by most of such workers at such excavation work.

4.14 Tunnelling Works

4.14.1 The Contractor shall appoint a responsible person for safe operation for tunnelling work as per BOCWR.

4.14.2 In addition to general precaution such as display of warning sign/notices, deployment of trained staff, housekeeping, etc., the Contractor shall ensure that:

- a) All portable electrical hand tools and inspection lamp used in underground and confined space at an excavation or tunnelling work is operated at a voltage not exceeding 24V;
- b) Every compressed air system in a tunnel is provided with emergency power supply for maintained continued supply of compressed air as per Rule 155 of BOCWR.
- c) Only flame proof equipment of appropriate type as per IS: 5571:2000 and or another relevant national standard is used inside the tunnel;
- d) Petrol or LPG of any other flammable substances are not used, stored inside the tunnel except with prior approval from the Engineer, and no oxy-acetylene gas is used in a compressed air environment in excavation or tunnelling;
- e) Adequate number of water outlets provided for firefighting purpose, an audible fire alarm and adequate number and types of fire extinguishers are provided and maintained;
- f) Temperature in any working chamber in an excavation or tunnelling work where workers employed does not exceed 29°C as per Rule 165 of BOCWR;
- g) All working areas in a free air tunnel are provided with ventilation system as approved by the Chief Inspector of Government of Haryana and the fresh air supplied in such tunnel is

not less than 6 m³/min for each worker employed in tunnel and the free air flow movement inside such tunnel is not less than 9.0 m/min as per Rule 153 of BOCWR;

- h) The oxygen level shall not be less than 19.5% in the working environment;
- i) The excavated areas are made safe by use of suitably designed and installed steel sets, rock bolts or similar other means;
- j) The responsible person referred to in BOCWR examines and inspects the workplaces in a tunnel before the commencement of work in such tunnel, and at regular intervals thereafter, to ensure safety of the Workers in such tunnel;
- k) The portal areas of a tunnel with loose soil, or rock, likely to cause injury to a person are adequately protected with supports;
- l) The Contractor shall ensure safe means of access to enter into tunnel.
- m) The Contractor shall establish controlled Access/Egress system for the tunnel entry. Tally board system shall be adopted where any person entering the tunnel shall register his/her details before entering.
- n) The Contractor shall ensure continuous gas monitoring inside the tunnel before and after the blasting. Monitoring of the gas shall also be conducted with the help of hand held gas monitors. Such instrument shall be calibrated on regular basis.
- o) The Contractor shall install emergency illumination (with battery backup) at an interval of not less than 15 m.

4.14.3 Means of Communication

The Contractor shall ensure that: reliable and effective means of communication such as the telephone or walkie-talkie is provided and are maintained in working order for arranging better and effective communication at an excavation as per Rule 136 of BOCWR.

4.14.4 Permissible Limit of Exposure of Chemicals

The Contractor shall ensure that the responsible person referred to in BOCWR conducts necessary test before the commencement of a tunnelling work for the day and at suitable intervals as fixed by Chief Inspector to ensure that the permissible limits of exposure are not exceeded, and a record of such test is maintained and is made available for inspection to Chief Inspector, on demand.

4.14.5 Evacuation and Training

The Contractor shall ensure that:

- a) Implementation of the training for evacuation and fire fighting immediately before the distance reaches about 100m from the portal to the tunnel face; and
- b) Implementation of evacuation training by a responsible person appointed in terms of dealing with technical matters.

4.15 Material Transportation

- 4.15.1 The Contractor shall develop the method statement for heavy/big material/machinery transportation such as Rolling Stock, Transformer, and Bridge Main Girder, etc.
- 4.15.2 The Contractor shall ensure that the person in charge should inspects the safety implementation like properly fixing of wire with vehicle slab bed, condition of vehicle breaks etc. before starting the job.
- 4.15.3 The Contractor shall ensure that every vehicle/moving machinery should have a signal man who has a whistle, a flag or a signal light (in the night) with striking clothes and stands at a safe visible place from a machine operator by means of the proper signal and way determined.
- 4.15.4 Training related to moving and parking safely should be given to driver/operator like parking

construction vehicles at a specified place with a parking brake and making sure to put a drag.

4.16 Foundation Works

The Contractor is required to evaluate the risk in each activity and suggest a control measures of piling works:

- a) Covering of bore holes with adequate warning signs;
- b) Cage to be lowered by using crane;
- c) The auxiliary hook of the rig shall not be used to pull or lower the cage in bore hole;
- d) The tremie pipe lowering and lifting after concreting shall be done by using crane;
- e) Control measure to arrest polymer spillage from the Site to avoid contaminating the surface drains;
- f) An entry restraining fence shall be provided around the pier excavation completion;
- g) No man suffering from any chronic disease, alcoholic excess, ear or heart troubles or having a sluggish blood circulation or who has excess of fat should be employed as a diver;

4.17 Batching Plant and Casting Yard

The Contractor is required to evaluate the risk in each activity and suggest Control Measures:

- a) Adequate space between the casting bed, segment storage area and the adjoining road shall be maintained so that a steel railing could be installed to segregate the gantry crane movement area from the road;
- b) All safety precautions stated in Sub-Clause 4.8 [Construction Machinery], Automatic Safe Load Indicator (ASLI) for crane and gantry shall be complied during erection of gantry crane and other equipment;
- c) The aggregate/sand storage area shall be kept under the full coverage of effective water sprinkler to avoid dust generation;
- d) The entire batching plant/aggregate storage Area shall be adequately walled of sufficient height, above which the Contractor is required to erect green dust protective net. This is a mandatory requirement to avoid dust in surrounding environment;
- e) The batching plant and casting yard required to obtain "Consent to Establish" and "Consent to Operate" certificate from State Pollution Control Board;
- f) LOTO (Lock Out Tag Out) system shall be installed.
- g) The batching plant/casting yard shall be barricaded and made as a compulsory Personal Protective Equipment (PPE) zone;
- h) Time office, canteen, drinking water, toilet and rest place shall be suitably located for the easy access to workers. All the facilities shall be properly cleaned and maintained during the entire period of operation;
- i) Drainage shall be effectively provided, and wastewater shall be disposed after proper treatment; and
- j) Manual handling of cement shall be avoided. Whenever it is necessary the workmen shall be given full body protection, hand protection and respiratory protection as a basic measure of ensuring better health.

4.18 Form Works

- a) Ensure the inspection of formwork assembly before and during the placement of concrete; and

- b) Ensure no attaching equipment to the formwork assembly unless specifically designed for this purpose; and not using a stripping process which may cause damage to the permanent structure.

4.19 Concrete Works

- a) Concrete pumping equipment, trucks etc. are not to be washed down on site and any waste-water, concrete slurry or other contaminants are to be contained, ball catcher should be used during washing of the concrete; and
- b) These contaminants are not to be discharged into or onto roadways, footpaths, gutters, drainage systems, watercourses or any other surface area that will result in damage to the environment or contravenes environmental legislation.

4.20 Pier Casting Works

- a) Using crane to hold the pier reinforcement during the time gap between de-staging and placement of shutter; and
- b) Location and pier height specific securing arrangement and specific Method Statement for pier more than 9.0 m shall be submitted and approved by the Engineer.

4.21 Bridge Erection Works

4.21.1 References:

- a) The BOCW Acts and Rules;
- b) The Haryana BOCW Rules 2005;
- c) Indian Railways Bridge Manual; and
- d) Safety Assessment with regard to Steel Bridge Erection Works 1985, Ministry of Health, Labour and Welfare;

4.21.2 General

As bridge erection works are one of the riskiest jobs, the Contractor shall take utmost precaution at all stages like; planning, establishing temporary yard, casting segments, transporting segments, fabrication and operation of erection machinery, if any, launching of segments/lifting of segments, pre-stressing, cutting and welding, auto (or manual) launching and dismantling of erection machineries. For pre-stressed concrete bridges, the Contractor shall further ensure that:

- a) a responsible person should be appointed for post-tensioning works testing and inspection of tendon tensioning devices and using material;
- b) installation of protective board behind a tensioning jack and keep out behind a jack during tensioning.
- c) use of protective glasses, laver gloves, and masks during grouting for safety of the Workers; and
- d) fall prevention installation of overall boarding at the bottom of a bridge and installation of funnel type boarding at the side of a bridge during construction in case of RFO (Railway Flyover) or ROB (Road over Bridge) for preventing the flying and fall of materials and tools by safety net, should be ensured.

4.21.3 The Contractors Obligation

The Contractor shall prepare a comprehensive method statement for the bridge erection works, adhering to the ESHS conditions laid down herein. Particular reference shall be made to the provisions on working at height. As the entire process of launching/lifting has to be undertaken at the Site especially during nighttime, the safety of workers is of paramount important. Daily inspection of scaffold structure and mechanical equipment for the traveller crane should be done.

4.21.4 Basic Consideration under Site Condition:

Erection works over or adjacent roads or highways:

- a) The work area should be demarcated properly, and route map and traffic management plan should be developed and implemented with proper signages and caution;
- b) The Contractor shall ensure the implementation of proper stop traffic and detour plan;
- c) The Contractor shall arrange the proper guide and signs to be followed while working on highway or adjacent roads, railways; and
- d) The Contractor should plan and establish all the required measures for the protection of overhead wires and buried utilities.
 - i) The regular inspection is done for all the installed protection equipment;
 - ii) The movement restriction site plan to be developed with defined operation path for safe working at site;
 - iii) watchmen should be appointed who are given training related to all type of traffic management and all signals used for smooth traffic flow and site transportation and works;
 - iv) The railway schedule is taken in consideration while planning the site works and ensures the safe management system with the details given regarding the kind of works suspended while a train is passing and clarifying the way of opening or closing railway in case of track closure works. For steel truss bridges;
 - v) The Contractor must install the protective net just after erecting truss upper chord material;
 - vi) The Contractor must install safety operation path to an end of erected member and a cross point of lateral bracing;

The Contractor may use any of the erection methods. However, following general points will be kept in view and ensured as applicable-

- A. The Contractor should develop and confirm the Engineer his Method Statement with details of position of bearing, jacking operation, roller passing etc.;
- B. Detailed inspection report related to the movement and condition of superstructure from the place of launching equipment and rollers should be given to the Engineer;
- C. The Contractor shall give confirmation of binding situation such as a bolting erection member;
- D. The Contractor shall give confirmation of displacement per every erection phase;
- E. The Contractor shall give confirmation of fixing situation for bearings;
- F. The Contractor must take measures to avoid a fall and lateral buckling of member; and
- G. The Contractor shall take measures of fall prevention for main superstructure.

4.22 Building and Roof Erection Works

4.22.1 The Contractor shall prepare plan, erection sequence and work procedures properly under competent and experienced personnel to ensure the safety of workers and prevent structure failure during erection:

- a) Contractor shall develop and confirm with the Engineer his method statement with details;
- b) The stability of structural members is to be ensured by means of ties, braces, anchor/fixing bolts, or other suitable means before releasing lifting gear, slings, chains etc.;
- c) Tag lines must be attached to the ends of components/loads to maintain control during crane lifting operations;
- d) Structure stability is to be ensured always. Unattended and incomplete buildings/structures are NOT to be left in an unsafe and hazardous condition, to pose a risk to the safety and

health of site personnel or the public;

- e) The Workers placing and securing roof battens are to be protected and are to work from an enclosed environment (e.g. scaffolding, deck guardrail or equivalent) and work up from the bottom of the truss/rafter towards and finish at the ridge /peak of the roof framing; and
- f) When the spacing of trusses and roof battens exceed 600mm the appropriate procedures are to be considered and applied after conducting a risk assessment to provide the optimum fall protection.

4.23 Overhead Contact Wire Works

4.23.1 During starting of works using rack vehicle/moving scaffold/ladder/insulation tower/step ladder, etc., the Contractor's operation in charge shall confirm as follows:

- a) The work sequence shall be determined while using Ariel Track vehicle. Communication system between drivers and conductors shall be developed and adopted;
- b) A deck which must be used by workers, shall have enough capacity of carry necessary loads for work at a high place with a pre-operation inspection;
- c) The workers shall be given the safety protection equipment which has enough capacity to hold necessary loads to prevent any accidental fall with a pre-operation inspection;
- d) State of electrical equipment installation and a route of going up and down from ground;
- e) The Worker is given required training for electrical works at height and the Worker must use a safety rope, an auxiliary rope, a fall prevention equipment such as a rolip which is a fall arrest device for a fixed rope when they work at high place;
- f) The Worker shall fix the grip of an auxiliary ropes at the upper position of their safety ropes and uses special wires or a lift when delivering materials and tools from ground to high place;
- g) The Contractor shall ensure that no one lean out of the rail of the track vehicles, or take a foot on the rail; and Shall take all the precautions for self-propellant or roll prevention when bringing the track vehicle to a stop;
- h) The installation of medium rail at the place where handrail is more than 85cm high;
- i) The training is given to all, for putting on a foot brake when bringing the rolling tower to a stop or working on the deck of the rolling tower suspended;
- j) Putting on a foot brake and fixing the insulation tower by an assistant when bringing the insulation tower to a stop or working on its suspension;

4.23.2 While going up and down along an Electric Pole, Power Pylon or a High Steel Structure or working above it, the Contractor shall ensure the safety precautions mentioned below:

- a) Use of a safety rope, an auxiliary rope and a fall prevention equipment with using an exclusive scaffold when going up and down along the electric pole;
- b) Use of an escort rail, or both a Full Body Harness and an auxiliary rope when going up and down along the power pylon or the high steel structure;
- c) While working on a Beam, the Contractor shall ensure the safety precautions mentioned below:
 - i. Use of a horizontal rope on working consecutively on the beam or painting the beam surface without an auxiliary rope; and
 - ii. Use of a safety rope and an auxiliary rope when moving on the beam under unavoidable circumstances.

4.24 Locomotives and Wagons

4.24.1 Speed limit is determined, and traffic signs of speed limits, lights and related hazards signage and

cautions shall be installed at work place.

- 4.24.2 Person in charge shall be nominated as maintenance officer to inspect and repair temporary rails or track surface situation regularly.
- 4.24.3 Ensure the installation of an alarm device such as a horn and a buzzer, a head light, and a flood light for the driver's seat.
- 4.24.4 Training and education shall be given to the driver and the signal man regarding how to send standard signal and operate vehicle diagram and turning off and putting on the brakes while the driver leaves his seat. And making sure to set wheel stoppers when stopping or parking at the slope track.
- 4.24.5 Each locomotive shall carry an extinguisher for fires

4.25 Fire Protection

- 4.25.1 The contractor shall ensure that the construction site is provided with—
 - a) Fire extinguishing equipment sufficient to extinguish any probable fire at such construction site;
 - b) An adequate water supply at ample pressure as per national standards;
 - c) Number of trained persons required to operate the fire extinguishing equipment provided; and
 - d) Is properly maintained and inspected at regular intervals of not less than once in a year by the responsible person and a record of such inspections is maintained.
- 4.25.2 The extinguishers shall be chosen as per type of fire load and surrounding location.
- 4.25.3 All construction machinery including crane shall carry a portable fire extinguisher in operator's cabin.
- 4.25.4 The Contractor shall prepare an emergency plan and Fire Evacuation plan and same shall be a part of Site ESHS Management Plan. Mock drills should be held on a quarterly basis to ensure the effectiveness of the arrangements and as a part of the programme, the telephone number of the local fire brigade should be prominently displayed near each telephone on site.
- 4.25.5 Recharging of fire extinguishers and their proper maintenance should be ensured and as a minimum should meet Indian National Standards.
- 4.25.6 All drivers of vehicles, foreman, supervisors and managers shall be trained on operating the fire extinguishers and firefighting equipment.

4.26 Demolition

- 4.26.1 All demolition works shall be carried out in a controlled manner under the management of experienced and competent supervision.
- 4.26.2 The concerned department of the Government or local authority should be informed, and permission obtained wherever required.
- 4.26.3 All glass or similar materials or articles in exterior openings should be removed before commencing any demolition work and all water, steam, electric; gas and other similar supply lines must be disconnected.
- 4.26.4 No demolition work should be performed if the adjacent structure seems to be unsafe unless and until remedial measures like sheet piling, shoring, bracing or similar means to be ensured for safety and stability for adjacent structure from collapsing.
- 4.26.5 Debris/bricks and other materials or articles should be removed by means of chute, bucket or other safe method.

4.26.6 No person other than the Workers or other persons essential to the operation of demolition work shall be permitted to enter a zone of demolition and the area be provided with substantial barricades.

4.27 Permit to Work

4.27.1 The Contractor shall develop work permit system, which is formal written system used to control certain types of work that are potentially hazardous. A work permit is a document, which specifies the work to be done, and the precautions to be taken.

4.27.2 Work Permits form an essential part of safe systems of work for many construction activities. They allow work to start only after safe procedures have been defined and they provide a clear record that all foreseeable hazards have been considered. Permits to Work are usually required in high-risk areas as identified by the Risk Assessments.

4.27.3 A permit is needed when construction work can only be carried out if normal safeguards are dropped or when new hazards are introduced by the work.

4.27.4 Examples of high-risk activities include but are not limited to:

- a) Entry into confined spaces;
- b) Hot work;
- c) To dig where underground services may be located;
- d) Work with heavy moving machinery;
- e) Heavy lifting operations and lifting operations closer to live electric power line;
- f) Work with using track motor vehicles etc.; and
- g) Work under electric facility and overhead electric (OHE) line energized.

4.27.5 The Contractor shall prepare operation manuals above mention and implement training course at any time based on such manuals to the Workers given completion of certificates before the commencement of works.

4.27.6 The permit-to-work system should be fully documented, laying down:

- a) How the system works;
- b) The jobs it is to be used for;
- c) The responsibilities and training of those involved; and
- d) How to check its operation.

4.27.7 A work permit authorization form shall be completed with the maximum duration period not exceeding 12 hours or end of shift, which is earlier.

4.27.8 A copy of each permit to work shall be displayed at work place. during its validity, in a conspicuous location in close proximity to the actual works location to which it applies.

4.28 Traffic Management and Site Barricading

4.28.1 The basic objective of the following guiding principles is to lay down procedures to be adopted by the Contractor to ensure the safe and efficient movement of traffic and also to ensure the safety of workmen in the all work areas.

4.28.2 The guiding principles to be adopted for safety in construction zone are to:

- a) Warn the road user clearly and sufficiently in advance;
- b) Provide safe and clearly marked lanes for guiding road users;
- c) Provide adequate traffic marshals to regulate the movement of traffic;
- d) Provide safe and clearly marked buffer and work zones; and

e) Provide adequate measures that control driver behaviour through construction zones.

- 4.28.3 In all cases, the Contractor shall take proper precautions. Wherever operations undertaken are likely to interfere with public traffic, Specific Traffic Management Plans shall be drawn up and implemented by the Contractor in consultation with the approval of Local Police Authorities and/or the concerned politburo/Civil Authorities and followed to the IRC: SP;55- 2014 (Guidelines on Traffic Management in work zones) & IRC: 67 (Code of Practice for Road Signs).
- 4.28.4 Full height fence, barriers, barricades etc. shall be erected around the site in order to prevent the working area from the risk of accidents due to speedy vehicular movement. Same the way barricades protect the road users from danger due to construction equipment and other temporary structures.
- 4.28.5 All barricades shall be conspicuously seen in the dark/nighttime by the road users so that no vehicle hits the barricade. Conspicuity shall be ensured by affixing retro reflective stripes of required size and shape at appropriate angles at the bottom and middle portion of the barricade at a minimum gap of 1000mm. In addition minimum one red light blinker or rope light should be placed at the top of each barricade.

4.29 Working near Railway

- 4.29.1 The details of Safe work procedure for work near Railway Track are given in Clause 8.0, Attachment -5 of this document.

4.30 Other Works to be Scrutinized

- 4.30.1 Other works including, but not be limited to, the works in the Site (the ROW), the works in the Borrow Pit, the works in the Quarry and Works on road shall be included to be scrutinised with respect to the accident prevention.
- 4.30.2 If blasting is anticipated in excavation in rock, preventive measures against accidents and protective measures against environmental/social impacts shall be of paramount importance.
- 4.30.3 The Contractor shall include all those items as well as work elements to formulate the preventive and protective measures considering envisaged conditions, situations, and activities of the works which may induce accidents or hazard to environment and/or society.

4.31 Personal Protective Equipment

- 4.31.1 The Contractor shall provide required PPEs to workmen to protect against safety and/or health hazards. Primarily PPEs are required for the following protection:
- a) Head protection (Safety helmet with a chin strap);
 - b) Foot protection (Safety footwear, Gumboot, etc.);
 - c) Body protection (High visibility clothing (Waistcoat/Jacket), Apron, etc.);
 - d) Personal fall protection (Full body harness, Rope-grip fall arrester, etc.);
 - e) Eye protection (Goggles, Welders Glasses, etc.);
 - f) Hand protection (Gloves, Finger coat, etc.);
 - g) Respiratory protection. (Nose mask, Self-contained breathing apparatus, etc.); and
 - h) Hearing protection (Ear plugs, Ear muffs, etc.).
- 4.31.2 The PPEs and safety appliances provided by the Contractor shall be of the standard as prescribed by Bureau of Indian Standards (BIS). If materials conforming to BIS standards are not available,.
- 4.31.3 The Contractor shall provide the PPEs which the Contractor deems necessary including; but not be limited to, safety helmets, safety shoes and Hi-Viz to all the Contractor's Employees including workmen (including those of its sub-contractors). High visibility clothing as per the following requirement.

- a) Hi-visibility jacket covering upper body and meeting the following requirements as per BS EN 471:1994;
- b) Background in fluorescent orange-red in colour;
- c) Jackets with full-length sleeves with two bands of retro reflective material, which shall be placed at the same height on the garment as those of the torso. The upper band shall encircle the upper part of the sleeves between the elbow and the shoulder; the bottom of the lower band shall not be less than 5cm from the bottom of the sleeve;
- d) Two vertical green strips of 5cm wide on front side, covering the torso at least 500 cm²;
- e) Two diagonal strips of 5 cm wide on back in an 'X' pattern covering at least 570cm²;
- f) Horizontal strips not less than 5cm wide running around the bottom of the vertical strip in front and 'X' pattern at back;
- g) The bottom strip shall be at a distance of 5cm from the bottom of the vest; and
- h) Strips shall be retro reflective and fluorescent.

Safety Helmet Colour Code (Every Helmet should have the LOGO*affixed/painted)	Person to use
Hard hat with company Logo (Employees)	Hard hat with reflective tape (Marshals)
White	Employer/Engineer
Grey	All designers, Architect, Consultants, etc.
Violet	Main Contractors (Engineers/Supervisors)
Blue	All subcontractors (Engineers/Supervisors)
Red	Electricians (Both Contractor and Subcontractor)
Green	Safety professionals (Both Contractor and Subcontractor)
Orange	Security guards/Traffic marshals
Yellow	All workmen
White (with "VISITOR" sticker)	Visitors
Safety Shoes (Anyone at the Siteincl. Marshals)	
All employees of the contractor including workmen	Traffic marshals

Note: LOGO-

- a) Logo shall have its outer dimension 2"X2" and shall be conspicuous
 - ii) Logo shall be either painted or affixed
 - iii) No words shall come either on Top / Bottom of Logo
- Logo of the corresponding main contracting company for their employees and sub-contracting company for their employees shall only be used.

- 4.31.4 In addition to the above any other PPEs required for any specific jobs like, welding and cutting, working at height, tunnelling etc. shall also be provided to all workmen and also ensure that all workmen use the PPEs properly while on the job.
- 4.31.5 The Contactor shall not pay any cash amount in lieu of PPEs to the workers/sub- contractors and expect them to buy and use during work.
- 4.31.6 The Contactor shall at all-time maintain a minimum of 10% spare PPEs and safety appliances and properly record and show to the Engineer during the inspections.
- 4.31.7 It is always the duty of the Contactor to provide the required PPEs for all visitors. Towards this required quantity of PPEs shall be kept always at the security post.

4.32 Visitor at Site

- 4.32.1 No visitor can enter the Site without permission. All authorised visitors should report at the Site office. The Contractor shall provide visitor's helmet (White helmet with visitor sticker) and other PPEs like Safety Shoe, reflective jacket, respiratory protection etc. as per requirement of the Site.
- 4.32.2 The Contractor shall be fully responsible for safety and health of all visitors within the Site.

4.33 Site Security

- 4.33.1 The Contractor shall be wholly responsible for security on the Site and any other areas being used by him or the Subcontractor's for the purposes of the Contract.
- 4.33.2 The Contractor shall assign on the Site a security officer (adequately trained person,) and his alternate(s), who shall be primarily responsible for the Contractor's security services and fully cooperate with the Engineer's security organization throughout the Time for Completion.
- 4.33.3 Where necessary, the Contractor shall install, modify, maintain the temporary security fences, gates, posts, security lightings and other facilities required for proper security control, in addition to those to be constructed as part of the Works. The Contractor shall operate these facilities to properly control ingress to and egress from the areas under his control throughout the Time for Completion. This control shall apply to every person including the Employer's Personnel.

5.0 OCCUPATIONAL HEALTH AND WELFARE

5.1 Physical Fitness of Workmen

- 5.1.1 The Contractor shall ensure that his employees/workers subject themselves to such medical examination as required under the law or under the contract provision and keep a record of the same.
- 5.1.2 The Contractor shall not permit any employee/workers to enter the work area under the influence of alcohol or any drugs.
- 5.1.3 The Contractor shall maintain the confidential records of medical examination or the physician authorized by the Engineer.
- 5.1.4 No worker is charged for the medical examination and the cost of such examination is borne by the Contactor employing such worker.

5.2 Medical Facilities

5.2.1 Occupational Health Centre (First Aid Station)

The Contractor shall ensure at the construction Site an occupational health center, mobile or static is provided and maintained in good order. Services and facilities as per the scale lay down in Schedule IV of HBOCWR. A construction medical officer appointed in an occupational health center, possess the qualification as laid down in Schedule V Rule no 113 of HBOCWR:

- 5.2.2 The Contractor shall appoint appropriate full-time staff including one nurse, one dresser- cum-compounder, one sweeper-cum-ward boy with each construction medical officer.

- 5.2.3 The Contractor shall communicate the complete details including name, qualification and experience of the construction medical officer, to the inspector having jurisdiction under HBOCWR.
- 5.2.4 Ambulance Room, Ambulance Van and Stretchers:
The Contractor shall ensure at a construction site of a building or other construction work that an ambulance van and room are provided at such construction Site, or an arrangement is made with a nearby hospital for providing such ambulance van for transportation of serious cases of accident or sickness of workers to hospital promptly and such ambulance van and room are maintained in good repair and is equipped with standard facilities specified in Schedule VI of Rule 114 & Schedule VII of Rule 115 of HBOCWR.
- 5.2.5 The Contractor shall provide enough stretchers at each site for use in an emergency.
- 5.2.6 First Aid Boxes and Emergency Care:
The Contractor shall ensure at construction site one First-aid box for 100 workers for providing first-aid to the workers. Every First-Aid box is distinctly marked "First-Aid" and is equipped with the articles specified in Schedule IX of Rule 119 of HBOCWR. Adequate no. of trained first aid persons shall be available at each work site in each shift.
- 5.2.7 HIV/AIDS Prevention and Control:
- The Contractor shall adopt the Employer's "Workplace Policy on HIV/AIDS Prevention and Control for Workers Engaged by Contractors" and implement it. A copy of the policy is given in Clause 8.0, Attachment-2 [Workplace Policy on HIV/AIDS Prevention & Control];
 - The Contractor shall prepare and submit the plan for HIV/AIDS Prevention and Control for his workers in terms of the aforesaid Employer's Policy within 28 days of the date of notification of the Contract.
 - The Contractor shall organize awareness program for labourers on the risks of AIDS and STDs in coordination with Haryana State AIDS Control society.
- 5.2.8 COVID -19 Prevention and Control
The Contractor shall ensure that the latest guidelines issued by Ministry of Health and Family Welfare (MoHFW), local government and the district administration are strictly followed at the construction works site. The Workplace Policy on COVID-19 Prevention and Control is given in Clause 8.0, Attachment-3 [Workplace Policy on COVID-19 Response]. The Contractor shall undertake a COVID-19 risk assessment of project area and prepare and submit COVID-19 Response and Management Plan.
- 5.2.9 Prevention of Mosquito Breeding
Measures shall be taken to prevent mosquito breeding on the Site. The measures to be taken shall include:
- Empty cans, oil drums, packing and other receptacles, which may retain water, shall be deposited at a central collection point and shall be removed from the site regularly;
 - Stagnant water shall be treated at least once every week with oil to prevent mosquito breeding;
 - The Contractor's equipment and other items on the site, which may retain water, shall be stored, covered, or treated in such a manner that water could not be retained; and
 - Water storage tanks shall be provided.
- 5.2.10 Posters in local language, Hindi and English, which draw attention to the dangers of permitting mosquito breeding, shall be displayed prominently on the Site.
- 5.2.11 The Contractor at periodic interval shall arrange to prevent mosquito breeding by fumigation/spraying of insecticides, and the ideal larvicide etc.

5.2.12 Alcohol, Smoking and Drugs

- a) The Contactor shall always ensure that no employee is working under the influence of alcohol/drugs which are punishable under BOCWR;
- b) Smoking at public places by any employee is also prohibited as per Government Regulations. The Contractor shall comply with the legal provisions in this regard, such as; Prohibition of Smoking in Public Places Rules, 2008. He shall be solely responsible for any penalty or punitive action by the government authorities because violations of the provisions contained in these rules by him or his representatives or his employees or his Subcontractors. Requisite notice boards, posters, etc., shall be put by him, as per the Rules.

5.3 Welfare Measures for Workers

5.3.1 Latrine and Urinal Accommodation:

- a) Latrine and urinals shall be provided as per Chapter VI, Part – II of Rule 80 of Haryana BOCWR and shall also comply with the requirements of public health authorities; and
- b) When women are employed, separate latrine and urinals accommodation shall be provided.

5.3.2 Moving Sites:

- a) In case of works like track laying, the zone of work is constantly moving. In such cases, mobile toilets with proper facility to drain the sludge shall be provided at reasonably accessible distance; and

5.3.3 Canteen

In every workplace wherein not less than 250 workers are employed, the Contractor shall provide an adequate canteen conforming to Chapter VI, Part – II of Rule 81 of Haryana BOCWR

5.3.4 Drinking Water.

As per Section 32 of BOCWA, the Contractor shall make in every site, effective arrangements to provide sufficient supply of wholesome drinking water. Quality of the drinking water shall conform to the requirements of national standards on Public Health Laws. While locating these drinking water facilities due care shall be taken so that these are easily accessible from the place of work for all workers at all location of the Site. All such points shall be legible marked "Drinking Water" in a language understood by most of the workmen employed.

5.3.5 Crèche

In every workplace where in more than 50 female workers are ordinarily employed, there shall be provided and maintained a suitable room for use of children under age of 6 years, conforming to the provisions of Section 35 of BOCWA.

5.3.6 Labour Accommodation Camps

The Contractor shall prepare Labour camp management plan as part of site ESHS plan. Where workers are based some distance from their normal place of residence, the Contractor shall provide them with suitable and safe accommodation free of charge and shall take all necessary precautions to protect their health and welfare. The accommodation shall conform to the requirements of Section 34 of BOCWA and include but not be limited to the further measures specified hereunder.

5.3.7 All accommodation camps shall be provided always with a sufficient supply of clean drinking water (of potable quality according to national legal standards), in suitable and easily accessible locations:

5.3.8 The quality of drinking water shall be tested once a fortnight as prescribed in IS 10500:2012 and immediate remedial action shall be taken if quality falls below the standard. Test results shall be provided to the Engineer at least monthly.

5.3.9 The Contractor shall provide all accommodation camps with clean and properly equipped and staffed kitchen and canteen facilities to supply meals for workers.

- 5.3.10 The Contractor shall provide sufficient toilet and bathroom facilities for the numbers of workers accommodated in each camp. Separate accommodation and toilet/bathroom facilities shall be provided for men and women and all facilities shall be kept in full working order always and cleaned and re-equipped daily.
- 5.3.11 The Contractor shall provide a laundry facility at the Labour Accommodation Camps.

6.0 ENVIRONMENT AND SOCIAL MANAGEMENT

6.1 General Conduct of the Works

- 6.1.1 The purpose and objective of these guidelines is to outline how the project will avoid, minimise or mitigate effects on the environment and surrounding area. These guidelines detail the implementation of measures in accordance with environmental and social commitments of HRIDC. These guidelines will be 'live' guidelines that will be reviewed and updated at regular intervals throughout the project life cycle. These guidelines will ensure that the development is compliant with current Environmental and Social legislations and will guide and assist the Contractor in exploring all reasonable and feasible means for reducing construction related Environmental and Social impacts.
- 6.1.2 The Contractor shall comply with the Environment and Social Management Plan (ESMP) given in the Environmental and Social Impact Assessment (ESIA) report available on HRIDC portal for information disclosure and will note and implement any requirements therein, in addition to those found in this specification.
- 6.1.3 The Contractor is required to build good public relations before the commencement of the Works particularly with the local level representatives such as the Gram Panchayat, by informing the expected impacts by the Works and their schedule and dispute resolution mechanism known as GRM set by the Employer.

6.2 Environmental Legislation

- 6.2.1 The Contractor shall always comply with all relevant National and State legislations regarding environmental protection, pollution prevention and control, waste management and other relevant environmental matters, including but not necessarily limited to, the following with their latest amendments:
- a) The Environment (Protection) Act, 1986 and Rules 1986
 - b) The Indian Wildlife (Protection) Act, 1972;
 - c) The Forest (Conservation) Act, 1980 & Rules;
 - d) Punjab Land Preservation Act, 1900;
 - e) The Noise Pollution (Regulation and Control) Rules, 2000;
 - f) Notification on Control of Noise from Diesel Generator (DG) sets, 2002;
 - g) The Air (Prevention and Control of Pollution) Act, 1981 and Rules 1981;
 - h) The Water (Prevention and Control of Pollution) Act, 1974 and Rules 1974;
 - i) Guidelines to control and regulate ground water extraction in India, 24th September 2020, Central Ground Water Authority;
 - j) The Solid Management Rules, 2016;
 - k) The Construction and Demolition Waste Management Rules, 2016;
 - l) The Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016;
 - m) The Bio-medical Waste Management Rules, 2016;
 - n) Plastic Waste Management Rules, 2016;
 - o) E-Waste (Management) Rules 2016;
 - p) The Batteries (Management and Handling) Rules, 2001;
 - q) Manufacture, Storage, and Import of Hazardous Chemical (Amendment) Rules, 1989;

- r) Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act 2010;
- s) Fly ash utilization notification, Sept 1999;
- t) Applicable NGT Guidelines issued time to time; and
- u) Provisions of Graded Response Action Plan notified by the MoEF&CC.
- 6.2.2 The Contractor shall comply the Environmental and Social Framework (ESF) of Asian Infrastructure Investment Bank (AIIB) February 2016.
- 6.2.3 If the requirements stated in this document are in conflict or inconsistent with the requirements of applicable laws, the more stringent requirements shall apply.
- 6.2.4 It is also the Contractor's responsibility to obtain all environmental clearances, official approvals, consents, or other authorizations as may be necessary to comply with the relevant statutes, and to pay all related fees and other costs. The Contractor shall obtain all authorizations in a timely manner and submit to the Engineer as the evidence for the regulatory obligations before commencement of any related construction activity. The indicative clearances/permission/permit are presented in Table below and Contractor is required to take any other clearance as required for its construction activities.

Clearance/ Permission/Permit	Relevant Acts/Rules	Concerned Agency
Consent to Establish and Consent to Operate batching plants and casting yards	<ul style="list-style-type: none"> The Water (Prevention and Control of Pollution) Act, 1974, and its amendments; The Air (Prevention and Control of Pollution) Act 1981 and its amendments 	Haryana Pollution Control Board
Authorization for generation, handling, storage, and transportation of hazardous waste	Hazardous and other Wastes (Management & Transboundary Movement) Rules, 2016	Haryana Pollution Control Board
Permission for extraction of ground water	Central Ground Water Authority guidelines to regulate and control ground water extraction in India, 24 th September, 2020	Haryana Water Resources (Conservation, Regulation and Management) Authority
Pollution Under Control Certificate	Central Motor and Vehicle Act 1998 Vehicular Exhaust Norms, CPCB 2007	Department of Transport, Government of Haryana
Construction and Demolition Waste Management Plan	Construction & Demolition Waste Management Rules, 2016	Local Authority (Municipal Corporation)

6.3 Environmentally Friendly Construction Practices

6.3.1 Containment of Air Pollution

- a) All construction equipment's should be cleaned of visible dirt/mud before exiting the construction sites and streets shall be promptly cleaned by manual sweeping, or by deploying electro – mechanical devices if such material has been dropped;
- b) The Contractor shall provide a wash pit or a wheel washing and/or vehicle cleaning facility at the exits from work sites such as construction depots and batching plants. This facility will be provided with efficient drainage, water re-circulation apparatus and silt traps to prevent any excessive buildup of water. Where wheel-washing facility is not possible, the Contractor shall ensure manual cleaning of wheels by wire brushes or similar suitable means;
- c) The Contractor shall ensure that vehicles carrying dust generating material shall be covered with tarpaulin, shall have properly fitted side and tailboards and dust potential material shall not be loaded to a level higher than the side and tail boards;
- d) Materials should not be dropped from more than 1.5 m to limit fugitive dust generation;
- e) Necessary water sprinkling to be carried out for dust control. For water sprinkling, emphasis should be given on use STP treated water or RO reject water;
- f) Stockpiles of sand and aggregate greater than 20m³ for use in concrete manufacture shall be enclosed on three sides, with walls extending above the stockpile and two (2) meters beyond the front of the stockpile;
- g) Areas within the Site such as construction depots and batching plants, where there is a regular movement of vehicles shall have an approved hard surface that is kept clear of loose surface material;
- h) Unless the Engineer has given notice otherwise, the Contractor shall restrict all motorised vehicles on the Site to a maximum speed of 15 kilometers per hour and confine haulage and delivery vehicles to the designated roadways inside the site;
- i) The Contractor shall erect hoardings as specified in Engineer requirements securely around all construction work sites during the main construction activity, to contain dust within the site area and also to reduce air turbulence caused by passing traffic. The hoarding shall be safely secured to the ground to prevent from toppling with minimum gap between the base of hoarding and ground surface.
- j) Water spray should be used to control dust during breaking of rock/concrete;
- k) The contractor shall take all necessary actions to control air pollution as per guidelines issued by the Commission for Air Quality Management (CAQM) in National Capital Region time to time;
- l) The contractor shall take necessary actions as per the provisions of Graded Response Action Plan (GRAP) issued from time to time.

6.3.2 **Containment of Water Pollution and Efficient Use of Water**

- a) List of sources (surface/ground) to be provided for approval from Engineer;
- b) A water meter shall be installed to quantify the consumption of water;
- c) Prior to use of source, written permission to be obtained from authority to use the water in construction activity, and submit a copy to Engineer;
- d) During construction only permitted quantity (permission taken) from approved sources to be used in construction activity;
- e) A Drainage system should be constructed during the commencement of the works, drain off all surface water at the site into suitable drains;
- f) At construction depots and batching plants temporary drainage works should be maintained, removed, and reinstated as necessary and all other necessary precautions should be taken for avoidance of damage by flooding and silt;

- g) The Contractor shall provide a hard surface with suitable drainage system for Transit Mixture washing at Casting Yard and/or Batching plant. The slurry water from Transit Mixture washing area shall go to sedimentation tank of suitable capacity to treat the slurry water. The contractor shall ensure the facility remains functional till the end of the contract;
- h) The Contractor shall take measures to prevent discharge of oil on land and in water bodies. Oil separator/interceptors shall be provided at Batching Plant and Construction Depot location for vehicle maintenance to prevent the release of oils and grease into the drainage system. These shall be cleaned on a regular basis;
- i) Rainwater pumped out from trenches or foundation excavation should be discharged into storm water drains after obtaining notice of no objection from the Agency controlling the system;
- j) The Contractor shall always ensure that all existing wells, stream courses and drains within, and adjacent to the site are kept safe and free from any debris and any excavated materials arising from the Works;
- k) The Contractor shall discharge wastewater arising from site offices, canteens or toilet facilities constructed by him into sewers after obtaining prior notice of no objection of agency controlling the system;
- l) The Contractor shall ensure that earth, bentonite, chemicals and concrete agitator washings etc. are not deposited/drained in the watercourses but are suitably treated and effluents and residue disposed off in a manner approved by local Regulatory Authorities;
- m) Construction works should be programmed to minimize soil excavation works in rainy season. If carried out during rains, temporarily exposed slope surfaces should be covered by tarpaulin, and temporary access roads should be protected by crushed stone or gravel, as excavation proceeds.
- n) Wastewater from Concrete Batching & Precast Concrete Casting and that generated from the washing down of mixer trucks and drum mixers and similar equipment should wherever practicable be recycled. The discharge of wastewater should be kept to a minimum;
- o) The road between the vehicle washing bay and the public road should be paved to reduce vehicle tracking of soil and to prevent site run-off from entering public road drains;

6.3.3 Containment of Noise and Vibration

- a) Contractor shall minimize the use of impact devices, such as jackhammers, and pavement breakers and instead use concrete crushers or pavement saws;
- b) Equip noise producing equipment such as jackhammers and pavement breakers with acoustically attenuating shields or shrouds recommended by the manufacturers thereof, to meet relevant noise limitations;
- c) Use hydraulic tools instead of pneumatic impact tools and electric instead of diesel-powered equipment. If pneumatic impact tools and equipment are used, they shall have intake and exhaust mufflers recommended by the manufacturers thereof, to meet relevant noise limitations;
- d) Provide mufflers or shield panelling for other equipment, including internal combustion engines, recommended by manufacturers thereof;
- e) Employ prefabricated structures instead of assembling on-site;
- f) Provide enclosures for stationary equipment and barriers around noisy areas;
- g) Locate and operate stationary equipment in such a way, so as to minimize noise and vibration impact on community, sensitive locations and nearby buildings.
- h) Schedule truck loading, unloading, and hauling operations in such a way so as to minimize

- noise impact near noise sensitive locations and surrounding communities;
- i) Plan noisier operations during times of highest ambient noise level, keep noise levels relatively uniform and avoid excessive and impulse noises;
 - j) Use only well-maintained, regular serviced plant/equipment, and not to be kept idling when not in use;
 - k) Maintain equipment such that parts of vehicles and loads are secure against vibrations and rattling;
 - l) Grading of surface irregularities on construction sites to prevent the generation of impact noise and ground vibrations by passing vehicles;
 - m) If back-up alarms are used on construction equipment, their noise emission level near noise sensitive receptors such as residences, schools, hospitals and similar areas where calmness is essential, should be regulated, especially at night time;
 - n) Avoid operating truck on streets that pass by schools during school hours;
 - o) Efforts to be made to bring down the noise levels due to the DG set, outside the premises, within the ambient noise requirements by proper setting and control measures;
 - p) The Contractor shall ensure that all necessary permissions/ approvals/consent is obtained from relevant authorities before installation and operation of Generator set;
 - q) A proper routine and preventive maintenance procedure for the DG set should be set and followed in consultation with the DG set manufacture;
 - r) At all times noise levels of DG sets shall comply the standards set out by CPCB/SPCB;

6.3.4 **Containment of Waste**

- a) Construction activities are expected to generate a variety of waste such as:
 - i) General refuse;
 - ii) Construction and Demolition waste including waste from excavated material;
 - iii) Chemical waste;
 - iv) Hazardous waste; and
 - v) Biomedical waste.
- b) The Contractor is required to develop, institute and maintain a Waste Management Plan (WMP) during the construction of the project for his works. Such mechanism is intended to ensure that the designated area for the segregation and temporary storage of reusable and recyclable materials are incorporated in the WMP. The WMP shall be prepared and submitted to Engineer for approval.

General Refuse

- c) General refuse like paper and food waste shall be stored in enclosed bins.
- d) The refuse shall be stored and transported in accordance with good practice and disposed at licensed landfills;
- e) An authorized waste collector shall be employed by the Contractor to remove general refuse from the site, on a daily basis to minimise odour, pest and litter impacts;
- f) The Contractor shall not burn debris or vegetation on the site.

Construction and Demolition (C&D) Waste

- g) C&D Waste would mainly arise from the project construction activities and from the demolition of existing structures where necessitated. It will include: material and equipment

wrapping packaging material, unusable/surplus concrete/grouting mixes, damaged/contaminated/surplus construction materials, wood from formwork and false work, concrete rubble, plastics, metal, glass, asphalt, wood and refuse obtained from demolition of houses.

- h) The Contractor shall be responsible for collection, segregation, storage and disposal of C&D waste as directed or notified by the concerned local authority in consonance with the Construction & Demolition Waste Management Rules, 2016;
- i) The Contractor shall ensure that there is no littering, deposition and disposal of C&D waste along the natural drainage and in water body;
- j) The C&D waste should be disposed off either when the quantity of C&D waste is 15 Tons from entire contract or such C&D waste has been stored for 15 days (irrespective of quantity) whichever is earlier;
- k) A proper arrangement for record keeping has to be maintained to ensure disposal of C&D waste to C&D waste recycling plant. Contractor shall submit the record of C&D waste disposal to recycling facility, in his Monthly Environment Report;

Hazardous Waste

- l) Hazardous waste would mainly arise from the maintenance of equipment. These may include, but not be limited to: Used engine oils, hydraulic fluids, waste fuel, spent mineral oils/cleaning fluids from mechanical machinery, scrap batteries or spent acid/alkali, spent solvents/solutions. Hazardous waste shall be disposed off in a manner in compliance with the procedure given in "Hazardous Waste (management, handling and trans-boundary movement) rules, 2016" only to authorized recyclers under intimation to the Employer's Representative;
- m) Chemicals classified as hazardous chemicals under "Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 of Environment (Protection) Act, 1986 shall be disposed off in a manner in compliance with the procedure given in the rules under the aforesaid act;
- n) The hazardous waste shall be stored on an impermeable surface with containment bunding to retain leaks, spills and ruptures;
- o) All waste collection containers shall be of appropriate size with a closed lid. Each container will be clearly labelled with a colour code system in local language and English. Original labels of empty containers should be completely covered and the contents of the type of waste stored in the used containers clearly indicated;
- p) Drip pans of suitable size and numbers shall be used to collect oil leakage and spills. The area shall be cleaned after completion of maintenance/repair and generated waste disposed off in approved manner.

Bio medical waste

- q) Collection, segregation, storage and disposal of Bio Medical waste shall be in accordance with The Bio-medical Waste Management Rules, 2016;
- r) Storage time of waste shall be as less as possible so that waste storage, transportation and disposal is done within 48 hours;
- s) The contractor shall ensure that Posters/ placards for bio-medical waste segregation are installed at the point of generation;
- t) Disposal of biomedical waste shall be through a licensed waste collector, duly authorized by MoEF&CC or Haryana Pollution Control Board as the case may be. License of the waste collector shall be shown to the Employer's Representative on demand. Staff handling the biomedical waste shall be provided with PPEs;

Colour coding of Waste storage bins

u) All waste shall be stored in different coloured bins as per table below:

Type of Waste	Colour
Wet/Organic/ Bio-Degradable Waste	Green Bins with lids
Dry/Recyclable waste (excluding Bio-medical waste/ hazardous waste)	Blue
Bio-Medical waste	Red with lids
E-Waste	Black
Hazardous Waste	Brown
COVID Waste	Yellow

6.3.5 Landscape, Greenery and Aesthetics

a) As far as is reasonably practicable, the Contractor shall maintain ecological balance by preventing deforestation and defacing of natural landscape. In respect of ecological balance, the Contractor shall observe the following instructions.

- i) Prevent any avoidable destruction, scarring or defacing of natural surroundings in the vicinity of work;
- ii) Any damage shall be repaired, replanted or otherwise corrected at Contractor's expense.
- iii) Directional shielding for light used for illumination shall be used to prevent from striking adjacent areas, where feasible;

b) Tree Felling

- i) All trees and shrubs, which are not specifically required to be cleared or removed for construction purposes, shall be preserved and protected from any damage by use of protective barriers or other methods approved by Engineer;
- ii) The Contractor shall not fell, remove or dispose of any tree or forest produce in any land handed over to him for the construction of works and facilities related to project except with the previous permission obtained from the Forest Department;
- iii) Trees shall not be used for anchorage.

6.3.6 Energy Management

- a) The Contractor shall use energy efficient pumps and motors. The efficiency shall be measured during installation and also periodically;
- b) The Contractor should rigorously follow the maintenance regime of his DG sets;
- c) The Contractor shall maximize the use of energy efficient luminaries such as LED's, metal halide lamps and ensure optimum illumination levels to save energy;
- d) The Contractor shall make provision of Earth Leakage Circuit Breakers (ELCBS) to prevent loss of excessive earth currents which are unsafe;
- e) The Contractor shall plan in advance and select locations to receive and store material such that these are at the least distance from place of use;
- f) The Contractor shall design site offices for maximum daylight and minimum heat gain.

6.3.7 Archaeological And Historic Resources

- a) If any archeological and historic structure is likely to be affected, a resource protection plan shall be prepared by the Contractor in consultation with the Archaeological Survey of India (ASI) to identify and assess construction effects and seeks ways to avoid, minimize or mitigate adverse

effects on such monuments;

- b) The Contractor shall stop work immediately and notify the Engineer if, during construction, an archaeological or burial site is discovered. The work will not recommence until approval of the Engineer is obtained for the same.

6.3.8 Fly Ash

MoEF&CC fly ash notification dated September 1999 and its subsequent amendments makes it mandatory for use of fly ash-based products in construction activities located within 300Km from coal or lignite based thermal power plants. The Contractor shall use fly ash as a percentage substitution of cement, in concrete for certain structures and works as prescribed in the latest amendment. The Contractor shall provide details of usage of such products to Engineer and shall maintain a detailed record of usage of Fly Ash.

6.4 Environmental Monitoring

- 6.4.1 **Baseline Study:** Before commencement of actual construction work, all items and parameters as specified in ESHS manual shall be monitored once as the baseline of the environmental condition prior to the construction and compared with the monitored values during the construction period;

- 6.4.2 **Qualification of Monitoring Agency:** Monitoring shall be conducted by MoEF&CC approved or NABL accredited laboratory and approved by the Engineer;

- 6.4.3 **Enforcement of the Monitoring:** Monitoring plan shall be proposed in the Contractor's ESHS Management Plan and must be approved by the Engineer before commencement of the monitoring. If the monitoring results are more than baseline and standards, cause analyses and necessary counter measures shall be proposed to the Engineer in the monitoring reports;

- 6.4.4 **Parameters, Location and Frequency of the Monitoring:** Environmental Monitoring parameters, locations and frequency is given in following table.

Parameters, Standards, Location and Frequency of Monitoring

Parameters	Sampling Standards	Location	Frequency
Air (PM ₁₀ , PM _{2.5})	CPCB (2011) Guidelines for the Measurement of Ambient Air Pollutants, Manual Sampling & Analyses	One representative location within each construction yard and batching plant	Monthly
		Closest residential or commercial area (one location) within 100m from each active construction site or representative locations approved by the Engineer.	Monthly
		PM _{2.5} In Tunnel portion	Bi-weekly
Noise Day Time (6 AM – 10PM) L _{max} , L _{min} , L _{eq} , L ₁₀ , L ₉₀ , L ₅₀	CPCB (2015) Protocol for Ambient Level Noise Monitoring	One representative location within each construction yard and batching plant	Weekly

Parameters	Sampling Standards	Location	Frequency
Night Time (10PM – 6AM) L_{max} , L_{min} , L_{eq} , L_{10} , L_{90} , L_{50}		Closest residential or commercial area (one location) within 100m from each active construction site or representative locations approved by the Engineer.	Weekly
Vibration (in mm/s or VdB)	IS 14884 (2000)	During complaints or as directed by employer.	
Drinking/GW (pH, Total Alkalinity, Electrical Conductivity, Total Dissolved Solids, Fluoride, Arsenic, Nitrate, Iron, Lead, Cadmium, E-coli)	IS 3025 (2008) & IS 10500 (2012)	Drinking water: construction yard, batching plant and labour camps	Quarterly (April, July, October, January)
		Groundwater: one representative tube/bore well in the adjacent residential area or within 100m from each active construction site	Quarterly (April, July, October, January)
Surface Water pH, Total Dissolved Solids, Fluoride, Arsenic, Iron, Lead, E-coli	IS 3025 (2008) & IS 2296 (1982) & CPCB (2012) Guide Manual Water and Wastewater Analysis	Upstream and downstream of the river/stream if any. Any natural water course (ex. Pond etc.) located or within 100 m of each a) construction yard, b) labour camp, and c) active construction site	Quarterly (April, July, October, January)
Waste	Not available but fully complying with monitoring the quantities of wastes specified by the Solid Management Rules 2016 & the Construction and Demolition Waste Management Rules 2016	Each construction yard and construction site	Quarterly (April, July, October, January)

Parameters	Sampling Standards	Location	Frequency
Hazardous waste	Not available but typed reporting (not handwriting) fully complying with monitoring the quantities of wastes specified by the Hazardous and Other Wastes (Management and Transboundary Movement) Rules 2016,	Each construction yard and active construction site	Quarterly (April, July, October, January)
Complaints if any		All Works' related locations	Weekly

6.5 Complaint Response Process

- 6.5.1 Enquiries, complaints and requests for information can be expected from a wide range of individuals and organisations both private and government. Most complaints are likely to be received by HRIDC, although the site offices are also likely to be contacted;
- 6.5.2 The objective of complaint process is to ensure that public and agency complaints are addressed and resolved consistently and expeditiously;
- 6.5.3 The Contractor's Project Manager will be notified immediately on receipt of complaint that may relate to environmental impacts. The Project Manager will immediately inform the Engineer;
- 6.5.4 Field investigation shall determine whether the complaint has merit, and if so, action shall be taken to address the complaint;
- 6.5.5 The outcome of the investigation and the action taken shall be documented on a complaint Performa prepared by the Contractor and submitted for notice by the Engineer in advance of the works;
- 6.5.6 Where possible, a formal response to each complaint received shall be prepared by the Contractor within seven days to notify the concerned person(s) that action has been taken.

6.6 Social Legal Requirement

- 6.6.1 The Contractor shall always comply with all relevant national and state legislations regarding social safeguard including but not necessarily limited to, the following with their latest amendments.
- National Policy for the Empowerment of Women, 2001;
 - The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013;
 - The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Rules, 2013;
 - The Protection of Children from Sexual Offences Act, 2012;
 - The Human Immunodeficiency Virus and Acquired Immune Deficiency Syndrome (Prevention and Control) Act, 2017;
 - Child Labour (Prohibition & Regulation) Act 1986

Some of the key International instruments for the protection of women include the following:

- United Nations General Assembly, Resolution 52/86 on Crime Prevention and Criminal

Justice Measures to Eliminate Violence Against Women, 2 February 1998;

- b) United Nations Security Council Resolution 1325 on Women, Peace and Security, 31 October 2000;
- c) Environmental and Social Framework (ESF) of Asian Infrastructure Investment Bank (AIIB) February 2016

6.7 Gender equality

- 6.7.1 The Contractor is responsible for providing equal opportunities to both genders and end gender related discrimination, if any. The ESHS Committee will proactively identify cases of gender discrimination with key focus on the following topics:
 - a) Gender based violence, including sexual harassment at the workplace;
 - b) Disparity in benefits provided;
 - c) Termination on account of pregnancy.
- 6.7.2 The Contractor shall enhance female workforce participation and maintain sex -disaggregated data for periodic reporting.
- 6.7.3 The Contractor shall ensure that women workers are paid at par with male workers
- 6.7.4 If women workers are deployed at site then day crèche facilities shall be provided to facilitate the women with infant working on site.

6.8 Labour Requirements

- 6.8.1 The contractor shall use unskilled labour drawn from local communities to avoid any additional stress on the existing facilities (medical services, power, water supply etc.)
- 6.8.2 The recruitment of women and members of vulnerable groups shall be prioritized.
- 6.8.3 The Contractor shall provide training to build the skills of locally recruited labour.
- 6.8.4 All staff, skilled and unskilled labours employed on a site shall be required to sign Code of Conduct that shall ensure compliance with the ESHS provision (Refer 6.11).

6.9 Cultural and Religious Issues

- 6.9.1 Disturbance from construction works to the cultural and religious sites, and Contractors lack of knowledge on cultural issues cause social disturbances. The Contractor shall
 - a) Communicate to the public through community consultation, informing the peers and newspaper announcements regarding the scope and schedule of construction, as well as certain construction activities causing disruptions or access restriction;
 - b) Not block access to cultural and religious sites and sites of importance for livelihood activities, wherever possible;
 - c) Need to take mitigation measures while working near religious place/ educational institutions close to the construction sites;
 - d) Provide freedom to construction workers to observe their cultural and religious practices;
 - e) Monitor and be responsible for the behaviour of construction workers especially migrant workers towards the community. The workers must be debriefed well regarding local aspects and need to follow good behaviours, and informed regarding unexpected behaviours at the time of employing;
 - f) Provision of cultural sensitization training for migrant labours regarding engagement with local community;
 - g) Resolve cultural issues in consultation with local leaders and Project Manager;

- h) Establish a mechanism that allows local people to raise grievances (directly and indirectly) arising from the construction process;
- i) Inform the local authorities responsible for health, religious and security duly informed before commencement of civil works so as to maintain effective surveillance over public health, social and security matters.

6.10 Guidelines for Addressing GBV in Projects

- 6.10.1 The Contractor's ESHS Plan shall include implementation of Gender Based Violence (GBV), Sexual Exploitation and Abuse (SEA) and Sexual Harassment (SH) Prevention and Response Action Plan. This action plan shall describe Code of Conduct (CoC), mechanism to address such incidents, assess the project scenario and potential risks of GBV/SEA/SH, training plan for workers on GBV/SEA/SH and awareness programme amongst workers regarding socially, culturally appropriate behaviour that would ensure that the project community and women in particular are safe, secured, and not vulnerable to abuse. A sample GVB/SEA/SH action plan is given in Table below.

Table - GBV/SEA/SH Prevention Action Plan

Objective	Activity	Responsibility
Assess Potential Risk of GBV	Rapid assessment of worksite, project footprint (e.g. community structure, local self-governance, national regulations, history of incidence), type of workers (local or migrant) for possible GBV risk.	As part of the social impact assessment (to be updated at the time of construction).
Inclusive development	<ul style="list-style-type: none"> Engage women in project planning and implementation Incorporate women's feedback in project design and construction schedule Organize systematic consultations with women to ensure continuous feedback on projects and identify any gender-sensitive adverse impacts 	
Training – women	<ul style="list-style-type: none"> Sensitization of women on GBV and women's rights to avoid/avert such incidents Sensitization of women on actions to be taken in case of GBV 	
Training – men	<ul style="list-style-type: none"> Sensitization of male workers on GBV and women's rights to avoid/avert such incidents. Sensitization of male workers on actions to be taken in case of GBV Sensitization of male workers on appropriate socially and culturally acceptable behaviour towards women Training of managers on methods of 	

Objective	Activity	Responsibility
	dealing with cases of GBV.	
Awareness generation	<ul style="list-style-type: none"> • Distribution of leaflets propagating gender-appropriate behaviour. • Signing of self-declaration format on commitment towards gender-sensitive behaviour. • Awareness raising programme to the local communities on GBV/SEA,HIV/AIDS,COVID-19 and Human Trafficking. 	

6.10.2 The Contractor shall constitute an appropriate Grievance Redress Mechanism (GRM) for addressing grievances at worksite. Grievances of workers will be first brought to the attention of supervisor at site. Grievances not redressed by the supervisor within 7 days will be brought to the Grievance Redress Committee (GRC). The composition of GRC will have representatives from workers, women representative, ESHS staff of the Contractor ESHS staff of GC. The main responsibilities of the GRC are to: (i) provide support to workers on problems arising at worksite, (ii) record workers grievances, categorise, prioritize grievances and resolve them, (iii) immediately inform the Engineer of serious cases and (iv) report to workers on development regarding their grievances and decisions of GRC. The panel of the GRC will function without any prejudice or fear of retaliation. The well-being of the panel members will be protected by HRIDC. The GRC will redress the grievances within 14 days. The Contractor shall provide grievance box at Project Site Office.

6.10.3 This project has zero tolerance of any form of:

- a) **Gender-based violence (GBV)**, that is perpetrated against a person's will and that is based on socially ascribed gender-related differences between people.
- b) **Sexual exploitation and abuse (SEA)** which is attempted abuse of a position of vulnerability, differential power, or trust, for sexual purposes, including, but not limited to, profiting monetarily, socially or politically from the sexual exploitation of another.
- c) **Sexual harassment (SH)** which is unwelcome sexual advances, requests for sexual favors, and other unwanted verbal or physical conduct of a sexual nature.

6.10.4 Any incidence of GBV, SEA or SH should be reported to the Grievance Redress Committee (GRC). The panel of the GRC should take appropriate gender-sensitive actions to verify authenticity of the incident with due consideration to the safety, security, and dignity of the offended person. The investigation should be concluded within three days of receiving the report or as reasonably possible. Depending on the severity of the incident, the panel may report the case to appropriate authorities.

Following the investigation, the GRC shall recommend appropriate actions to the company which may include but not limited to:

- a) Informal warning
- b) Formal warning
- c) Additional training
- d) Loss of up to one week's salary
- e) Suspension of employment (without payment of salary), for a minimum period of one month up to a maximum of six months

f) Termination of employment

- 6.10.5 The affected person will be provided with appropriate support (e.g. psychological counselling, medical support and any other support as needed).
- 6.10.6 A self-declaration format for adherence to gender-sensitive behaviour should be signed by all contractors, subcontractors, employees, and senior managers, engaged by the Project to avoid GBV/SEA/SH at worksite. A self-declaration format is given in below:
- 6.10.7 **Commitment Statement for all Project Workers**

(to be translated into local language or explained in a manner that is appropriate for general understanding of the signee)

I, (name of person), acknowledge that preventing Gender-Based Violence (GBV), Sexual exploitation and abuse (SEA) and Sexual harassment (SH) is essential, and that preventing it is my responsibility. At [Company], GBV activities constitute acts of gross misconduct and are therefore grounds for sanctions, penalties or potential termination of employment. All forms of GBV are unacceptable, be it on the worksite, the worksite surroundings, at workers' camps, or in the community. Prosecution of those who commit GBV may be pursued if appropriate.

I agree that while working on the [Project], I will:

- Cooperate with any relevant investigations.
- Treat women, children (definition of "child" shall be as specified in Child Labour (Prohibition and Regulation) Act, 1986) and men with respect regardless of race; color; language; religion; political or other opinion; national, ethnic or social origin; sexual orientation or gender identity; disability; birth or other status.
- Not use language or behaviour towards women, children or men that is inappropriate, harassing, abusive, sexually provocative, demeaning or culturally inappropriate.
- Not request or engage in sexual favors - for instance, making promises or favorable treatment dependent on sexual acts, in or outside the work site.
- Refrain from abusive and violent behaviour, in the workplace, labor camp or surrounding communities.
- Attend and actively partake in training courses related to HIV/AIDS, GBV, SEA and SH as requested by my employer.
- Report through the grievance redress mechanism or to my manager any suspected or actual GBV by a fellow worker, whether in my company or not, or any breaches of this Code of Conduct.

[Company] recognizes that false accusations of sexual harassment can have serious effects on innocent persons. If, after the investigation, it is found that the complainant has maliciously or recklessly made a false accusation, the complainant will be subject to appropriate sanctions. In such a case, the company will also take appropriate action to restore the reputation of the accused.

I understand that it is my responsibility to use common sense and avoid actions or behaviours that could be construed as GBV or breach this Self-declaration format. I do hereby acknowledge that I have read the foregoing Self-declaration format, do agree to comply with the standards contained therein and understand my roles and responsibilities to prevent and respond to GBV. I understand that any action inconsistent with this Self-declaration format or failure to act, as mandated by this Self-declaration format may result in disciplinary action and may affect my ongoing employment.

I have familiarized myself with the contents of this Self-declaration format. By my signature below, I acknowledge, understand, accept and agree to comply with the information contained in

the Self-declaration format provided to me.

I hereby confirm I have read and understand the Self-declaration format.

Name (Employee)

Signature

Date

6.11 Code of Conduct for Contractor’s Workers

6.11.1 The Contractor shall have a Code of Conduct for the Contractor’s Personnel. The Contractor shall ensure that each Contractor’s Personnel is provided a copy of this Code of Conduct, written in a language comprehensible to that person, and shall seek to obtain that person’s signature acknowledging receipt of the same. Reference code of conduct is place below:.

Code of Conduct for Contractor’s Workers

We are the Contractor, [*enter name of Contractor*]. We have signed a contract with [*enter name of Employer*] for [*enter description of the Works*]. These Works will be carried out at [*enter the Site and other locations where the Works will be carried out*]. Our contract requires us to implement measures to address environmental and social risks related to the Works, including the risks of sexual exploitation and abuse and gender-based violence.

This Code of Conduct is part of the measures to deal with environmental and social risks involving the workers, related to the labor camps and the workplace. It applies to all our staff, laborers and other employees at the Works Site or other places where the Works are being carried out. It also applies to the personnel of each subcontractor and any other personnel assisting us in the execution of the Works. All such persons are referred to as “**Contractor’s Personnel**” and are subject to this Code of Conduct.

This Code of Conduct identifies the conduct that is required from all Contractor’s Personnel.

Our workplace is an environment where unsafe, offensive, abusive, or violent behavior will not be tolerated and where all persons should feel comfortable raising issues or concerns without fear of retaliation.

Contractor’s Personnel shall:

1. Make earnest efforts to understand his/her responsibilities detailed in this Code of Conduct and any other documents and training, as directed by the Employer. Proactive seek clarifications to enable work to be undertaken in strict compliance with this Code of Conduct.
2. Carry out his/her duties competently and diligently.
3. Comply with this Code of Conduct and all applicable laws, regulations, and other requirements, including requirements to protect the health, safety and well-being of other Contractor’s Workers and any other person.
4. Maintain a safe working environment including by:
 - a. ensuring that workplaces, machinery, equipment, and processes under each person’s control are safe and without risk to health.
 - b. wearing required personal protective equipment.

- c. all works are conducted with safety clearance and under appropriate supervision.
 - d. using appropriate measures relating to chemical, physical, and biological substances and agents.
 - e. following applicable emergency operating procedures.
 - f. providing separate, safe, and easily accessible working and accommodation facilities for women and men working on the site.
5. Report work situations that he/she believes are not safe or healthy and remove himself/herself from a work situation which he/she reasonably believes presents an imminent and serious danger to his/her life or health.
 6. Treat other people with respect, and not discriminate against specific groups such as women, gays, people with disabilities, migrant workers, or children.
 7. Not engage in sexual harassment which includes unwelcome sexual advances, requests for sexual favors, and other unwanted verbal or physical conduct of a sexual nature.
 8. When engaging with the community and/or project affected persons, this should be done professionally and with utmost respect. Intimidation, threats, and coercive behavior will not be tolerated.
 9. Not engage in sexual exploitation and abuse, which means any actual or attempted abuse of position of vulnerability, differential power or trust, for sexual purposes, including, but not limited to, profiting monetarily, socially or politically from the sexual exploitation of another.
 10. Not engage in sexual assault, which means any form of non-consensual sexual contact.
 11. Not engage in any form of sexual activity with individuals under the age of 18.
 12. Not make any inappropriate and unwanted sexual advances to people in the adjoining communities or settlements.
 13. Not work or be present in the worksite(s) under the influence of any intoxicating substances, such as alcohol or drugs.
 14. Not possess alcohol or any other intoxicating substances while on duty or in the labor camps.
 15. Return to the labor camp no later than 22:00, unless working on night shift.
 16. Complete relevant training courses that will be provided related to the environmental and social aspects of the Contract, including on health and safety matters, Gender-based violence (GBV), Sexual Exploitation, Abuse and Harassment (SEAH).
 17. Report violations of this Code of Conduct.
 18. Not retaliate against any person who reports violations of this Code of Conduct, whether to AIIB or the Employer, or who makes use of the grievance mechanism for Contractor's Workers or the project's Grievance Redress Mechanism.

RAISING CONCERNS

If any person observes behavior that he/she believes may represent a violation of this Code of Conduct, or that otherwise concerns him/her, he/she should raise the issue promptly. This can be done in either of the following ways:

1. Contact [*enter name of the Contractor's Social Expert*] in writing at this address [X] or by telephone at [X] or in person at [X]; or
2. Call [X] to reach the Contractor's hotline (*if any*) and leave a message.

The person's identity will be kept confidential, unless reporting of allegations is mandated by the country law. Anonymous complaints or allegations may also be submitted and will be given all due

and appropriate consideration. We take seriously all reports of possible misconduct and will investigate and take appropriate action. We will provide warm referrals to service providers that may help support the person who experienced the alleged incident, as appropriate.

There will be no retaliation against any person who raises a concern in good faith about any behavior prohibited by this Code of Conduct. Such retaliation would be a violation of this Code of Conduct.

CONSEQUENCES OF VIOLATING THE CODE OF CONDUCT

Any violation of this Code of Conduct by Contractor’s Personnel may result in serious consequences, up to and including termination and possible referral to legal authorities.

FOR CONTRACTOR’S PERSONNEL:

I have received a copy of this Code of Conduct written in [X] language that I comprehend. I understand that if I have any questions about this Code of Conduct, I can contact [*enter name of Contractor’s contact person with relevant experience in handling gender-based violence*] requesting an explanation.

Name of Contractor’s Personnel: [insert name]

Signature: _____

Date: (day month year): _____

Countersignature of authorized representative of the Contractor: [insert name]

Signature: _____

Date: (day month year): _____

7.0 FINANCIAL DEDUCTION/WITHHOLDING

7.1 Financial deductions from Contractor on occurrences of an incident.

- 7.1.1 Table No. 1 below indicates ESHS incidents and the corresponding deductions to be made from the Contractor under Sub-Clauses 20.1 [Employer's Claims], Sub-Clauses 14.3 [Application for Interim Payment], Sub-Clauses 14.6 [Issue of Interim Payment Certificates] and Sub-Clauses 14.7 [Payment] of the General Conditions of Contract.
- 7.1.2 The affected part of the Works shall remain suspended until all necessary investigations are completed as prescribed in Clause 2. [ESHS Management], Sub-Clause 2.15 Accident Report and Investigation and as per the related local laws of the state.
- 7.1.3 Upon submission of the Contractor's Request for Inspection (RFI), a joint inspection of the affected part of the Works shall be carried out by the Engineer and the Contractor. On receipt of the Engineer's Consent (Notice of No Objection: NONO), the Contractor may resume the work.
- 7.1.4 The Contractor shall not be entitled to any extension of time or to the payment of any cost or profit due to any suspension in accordance with this Sub-Clause 8.5 [Extension of time for Completion]
- 7.1.5 The maximum amount of delay damages set out in Sub-Clause 8.8 [Delay Damages] of the General Conditions of Contract shall not be applicable where the cause of delay to completion is suspension of part of the Works due to the Contractor's non-compliance as described in this clause 7.1.
- 7.1.6 The Engineer may issue a notice to the Contractor in accordance with Sub-Clause 3.5 [Engineer's Instruction] of the General Conditions of Contract to rectify any unsafe act or condition (including but not limited to error, default, or omission) upon discovery of same on the Site by the Engineer, in a form of Nonconformity Report.
- 7.1.7 The Contractor shall promptly comply with such notification, investigate the noncompliance of the Condition of Contract on ESHS and Project ESHS Manual as soon as possible (but no later than 7 days, or within such other period from receipt of the Engineer's notification as may be approved by the Engineer), submit to the Engineer for review full details of the proposed correction, prevention and any other measures (hereinafter referred to as the "measures") to be taken by the Contractor to rectify and close-out the matter and to prevent re-occurrence. Such measures shall be to the satisfaction of the Engineer.
- 7.1.8 The Contractor shall not proceed with the affected works until its measures are accepted by the Engineer.

Table No. 1: Incidents

Sl. No.	Incident		Financial deductions from the Contractor in Indian Rupees
1.	Injury and Incidence reporting	i) Fatal accidents ii) Injury accident	i) Rs.100,000 for the first fatality and Rs.200,000 for every subsequent fatality. ii) Rs.50,000 for first grievously injured person and Rs.75,000 for every subsequent grievously injured person (Grievous Injury as defined by Workmen's Compensation Act)

8.0 ATTACHMENT

Attachment -1 Contents of ESHS Management Plan

1.0 General

- 1.1 The Contractor shall prepare an Environment, Social, Health and Safety (ESHS) Management Plan, which provides measures to protect the Environment, Health and Safety of workers and the public.
- 1.2 The Contractor's ESHS Management Plan shall be based on Environment, Social, Health and Safety considerations submitted with the Tender and shall have the content shown in the following section [Contents of ESHS Management Plan].
- 1.3 The Contractor shall submit his ESHS Management Plan for review by the Engineer within 28 days after the Commencement Date and shall amend the ESHS Management Plan to address any comments made by the Engineer and submit a Final ESHS Management Plan within 14 days of receipt of comments.
- 1.4 The Final ESHS Management Plan shall be binding on the Contractor for the duration of the Contract.

2.0 Content of ESHS Management Plan

- 2.1 The Contractor's ESHS Management Plan shall cover the following aspects:

Site ESHS Management Plan	
Contract No.	
Contractor Name	
Project Name	
1	Project Highlights <ol style="list-style-type: none"> i) Title of the content; ii) Contract number; iii) Brief scope of work; iv) Location map/key plan; v) Period of the project;
2	ESHS Management Policy
3	Site organization chart Chart indicating reporting of ESHS Management personnel, appointment, duties, and responsibilities
4	Roles & responsibility Individual responsibility of the <ol style="list-style-type: none"> i) The Contractor's representative ii) Health & Safety Expert/manager iii) Environment Expert/manger

	<ul style="list-style-type: none"> iv) Social expert v) Construction manager vi) ESHS Committee members vii) ESHS Engineer viii) Site Engineer ix) Bridge Engineer x) Construction Supervisors xi) Subcontractors
5	<p>ESHS Site Committee</p> <ul style="list-style-type: none"> i) Details - Chairman, secretary, members, and employer's representative ii) Procedures for effective conduct of meeting
6	ESHS Training
7	Subcontractor Evaluation, Selection, Control and ESHS Code of Conduct
8	ESHS Inspection and audit
10	Accident, Incident, Near miss, Dangerous occurrence, investigation reporting procedures
11	First Aid, Occupational Health and Emergencies measures
12	Staff and labour welfare measures
13	Hazards and Risks with Risk assessment and mitigation procedures
14	<p>Safe Work Procedures e.g.</p> <ul style="list-style-type: none"> i) Excavation ii) Structural steel erection iii) Form works iv) Concrete placement v) Work at height vi) Switch-over works vii) Floor, wall openings and stairways viii) Welding, cutting and bracing ix) Lifting appliances x) Electrical equipment xi) Mechanical equipment xii) Fire prevention xiii) Hazardous chemicals and solvent

	<ul style="list-style-type: none"> xiv) Lighting xv) Abrasive blasting xvi) Launching operation/girder erection.
15	Work permit system
16	List of standard job specific PPEs to be used in the site
17	Maintenance of regime for construction equipment and machinery
18	Traffic management plan
19	Housekeeping
20	<ul style="list-style-type: none"> i) Environmental and Social Management ii) Applicable National and State legislation and regulations iii) Specific procedures for achieving environmental and social performance requirements as given in the Employer's requirements on Environment. iv) Details on air monitoring and noise monitoring control plan which details mitigation measures / corrective action / preventive action and monitoring schedule. v) The ESHS Management Plan must contain procedures on prevention and control of water pollution, storage, handling and disposal of waste, including municipal, C&D, plastic, bio-medical, chemical and hazardous wastes, reuse/recycle of waste, selling to authorised recyclers and records thereof, preservation of landscape disturbed due to construction, housekeeping/Environmental sanitation and traffic management as required under the contract. vi) Procedures for recording environmental complaints and response process. vii) Waste Management Plan viii) HIV Prevention and Control Plan ix) Gender Based Violence (GBV) and sexual Exploitation and Abuse (SEA) Prevention and Response Plan x) COVID-19 Response and Management Plan xi) Labour Camp Management Plan
21	Emergency Response plan
22	Visitors and security arrangement
23	ESHS promotion and awareness;
24	ESHS equipment and ESHS of the Contractor's construction and office equipment;

Note: -The Environment, Social, Health and Safety (ESHS) Management Plan shall be incorporated in the relevant sections.

Attachment -2 Workplace Policy (on HIV/AIDS Prevention & Control)

Haryana Rail Infrastructure Development Corporation Limited (HRIDC) recognizes HIV/AIDS as a developmental challenge and realizes the need to respond to it by implementing regular HIV/AIDS prevention programmes and creating a non-discriminatory work environment for HIV infected workmen engaged by Contractors. For the purpose of making conscientious, sensitive and compassionate decision in addressing the realities of HIV/AIDS, HRIDC has established these guidelines based on ILO code of practice on HIV/AIDS.

- Creating awareness through professional agency using IEC (Information, Education and Communication) package specially designed for migrant workers.
- Institutional capacity building by training the project implementation team, Environmental, Social, Health & Safety (ESHS) Managers, establishing linkages for deficient diagnosis and treatment of the affected workers, effective monitoring of implementation and documentation for further learning.
- Establishing peer educators by selecting them in consultation with Contractors and training them through professional agencies so that they become focal point for any information, education and awareness campaigns among the workmen throughout the contract period.
- Promotion of social marketing of condom

Attachment -3 Workplace Policy on COVID-19 Prevention and Control

It is likely that Corona virus Disease 2019 (COVID-19) will continue to occur in the community in the foreseeable future. It is therefore necessary to have a plan/policy in place to prevent the spread of this virus within the workplace. In order to reduce the risk of infection, Haryana Rail Infrastructure Development Corporation Limited (HRIDC) recommends to the Contractor to consider the following measures:

- a) The Contractor shall ensure that the latest guidelines issued by Ministry of Health and Family Welfare (MoHFW), local government and the district administration are strictly followed at the construction works site.
- b) On day 0, before resuming the work on sites post lockdown period, mandatory medical check-up will be arranged for all workers.
- c) Only medically fit workers will be deployed at site and medical assistance will be arranged for unfit workers.
- d) A unique photo identity card with serial number will be issued to all the workers and their family members staying at site.
- e) All the essential items will be made available to them at site only. Mandatorily wear face masks while working on site or going outside.
- f) No outside worker will be allowed to stay at site without following proper procedure and instructions.
- g) The workers staying outside (which are always nearby) shall reach the site either by walking or by their individual mode of transport (bicycle, two-wheeler etc.).
- h) During attendance, training and other sessions, social distancing guidelines will be followed along with provision of no-touch attendance.
- i) All workers may be advised to take care of their own health and look out for respiratory symptoms/fever and, if feeling unwell, shall leave the workplace immediately after informing their reporting officers.
- j) Workers shall not shake hands when greeting others and while working on the site.
- k) Avoid large gatherings or meetings. Maintain at least 1 metre (3 feet) distance from persons, especially with those having flu-like symptoms, during interaction.
- l) Workers shall clean hands frequently by washing them with soap and water for at least 40 seconds.
- m) Workers shall not share their belongings like food, water bottles, utensils, mobile phones etc. with others.
- n) The utensils shall be washed properly post use at designated places.
- o) Post work, workers shall change their clothes before leaving the site and clothing shall not be shook out.
- p) Avoid touching your eyes, nose, or mouth with unwashed hands.

Attachment -4 Reference for ESHS Activities**General Instruction: ESHS/GI/001****Topics for ESHS Orientation Trainings for Workmen for First Day at Work****1) Hazard Identification Procedure**

Hazards on site:

- Working at Height, Electricity, lifting work, Work close to railway tracks or roads, Construction machinery and Safety of nearby located structures.

2) Personal Protective Equipment

- What is available?
- How to obtain it?
- Correct use and care.

3) Health

- Site welfare facilities;
- Potential health hazards;
- First Aid/Cardiopulmonary Resuscitation (CPR). /Automated External defibrillator (AED).

4) Duties of the Contractor

- Brief outline of the responsibilities of the Contractor by law;
- Details of the Contractor's ESHS Policy;
- The Employer ESHS Management Manual (if any);
- Building and other Constructions Welfare Law.

5) Employee's Duties

- Brief outline of responsibilities of employee under law

6) Environment And Social

- Contractor's Environment Policy
- Key legal requirements
- Avoidance of Nuisance
- Environmental Sanitation
- Dust Control Measures
- Water Pollution and Control
- Occupational noise mitigation
- Waste Management and Disposal
- Gender Based Violence and Sexual Exploitation and abuse (GBV/SEA)
- HIV/AIDS prevention
- Grievance Redressal Mechanism for GBV/SEA

General Instruction: ESHS/GI/002

ID CARD FORMAT (85 mm x 55mm) FRONT SIDE OF ID CARD:

The front side of the ID card template is enclosed in a rounded rectangular border. It features several fields: a 'Company Logo' box at the top left, a 'Contractor Details' box at the top right, and a central 'PROJECT NAME' field. Below the project name, there are five lines for personal information: 'Name:', 'Designation:', 'Blood Group:', 'Valid Up to:', and 'ID No:'. To the right of these fields is a square placeholder labeled 'PHOTO'. At the bottom right, there is a space for an 'Authorized Signatory'.

The back side of the ID card template is enclosed in a rounded rectangular border. It starts with an 'Employee Address:' field followed by two horizontal lines. Below this is a rectangular box containing three numbered lines of text: '1. This card is the property of XXXXXXXX and must be returned on demand and on transfer/cancellation of employment.', '2. A charge will be levied for replacement of this card due to loss or theft.', and '3. If found, please return it to below mentioned address.' At the bottom, there is a large rectangular box labeled 'OFFICE ADDRESS'.

General Instruction: ESHS/GI/003**WEEK/DAYS TO BE OBSERVED FOR CREATING ESHS AWARENESS**

1 st Monday to Sunday of January	Road Safety Week (Subjected to confirmation from Ministry of Road Transport, Govt. of India every year.)
16 th February	Kyoto Protocol Day
March	Red Cross Month
4 th March	National Safety Day
8 th March	International Women's Day
22 nd March	World Water Day
7 th April	World Health Day
14 th April	Fire Safety Day
18 th to 22 nd April	Earth Week
20 th April	Earth Day
20 th April	Noise Awareness Day
28 th April	ILO World Day for Safety and Health at Work Day
1 st to 7 th May	Emergency Preparedness Week
5 th June	World Environmental Day
12 th June	World Day against Child Labours
21 st June	World Yoga Day
9 th July	Occupational Health Day
17 th October	World Trauma Day
1 st December	World AIDS Day

General Instruction: ESHS/GI/004**Minimum Requirements of ESHS Communication Posters/Signage/Video:**

- a) Every Contractor shall prepare a ESHS Communication Plan as a part of site specific ESHS Management Plan and shall include the following minimum requirement of Posters/Signage/Video as applicable. In case readymade posters are available in any of the category from National Safety Council or any other safety related organizations they may procure the same and display it. In case the same is not available, then the Contractors shall make necessary arrangements to get the posters designed and printed on their own. All posters shall each be in Hindi, English and the regional language; and
- b) All the above is to be detailed in the Contractor's ESHS Management Plan and he shall obtain the Engineer's prior consent for the numbers, contents, locations, etc.

Table No.: 1 - Minimum No. of Posters

Sl. No	ESHS Poster Title	No. of Posters/Signages
1.	Daily Safety Oath	5
2.	Signage to display the messages like PPE ZONE, NO PPE ZONE, HARD HAT AREA etc.	5
a)	Helmet	5
b)	Shoe	5
c)	Goggles & Ear Protection	5
d)	Full Body Harness	5
e)	Hi-Vi Jacket	5
f)	Working at Heights	5
3.	Ladder, Stairway, Scaffold -Signage to display the messages like SAFE, UNSAFE, FIT FOR USE, AVOID USE etc.	5
a)	Site Electricity	5
4.	Crane Safety	5
5.	Rigging Procedures	5
6.	Excavation	5
7.		

7.	Occupational Health (Mosquito Control, HIV/AIDS awareness, DustControl, Noise Control, No Smoking/Spitting, etc.)	5
8.	First – Aid	5
9.	Labour Welfare Measures (Payment of Minimum Wages, Avoidance of Child labour, signing in the MusterRoll, in case of accidents- what to do? Etc.	5
10.	Traffic Safety (Speed limit, safe crossingand working within barricaded area etc.)	5
11.	Environmental Management	5

Note: The above minimum numbers are for guidance only. The actual number, material of posters/signages will be as per project specific requirement.

Table No.: 2 – Size of Posters/Signage

Sl. No	Item	Size
1.	Posters – Standard	17”x22” –135 GSM 4 Colour Printing
2.	Posters – Special (Wherever required)	17”x22” card laminated FA Poster
3.	Posters - Mega size (Wherever required)	32”x40” Flex FA Poster
4.	First-Aid Booklet	6”x4”
5.	Safety Handbook	6”x4”
6.	Signage	Small: 12”x6” Big: 24”x12”
7.	Road Traffic Sign Boards	Strictly as per Indian Road Congress (IRC) specifications

Table No.: 3 – Safety Signage Colour (as per IS: 9457)

Sl. No	Type of signage	Colour
1	Mandatory	Blue
2	Danger	Yellow
3	Prohibitory	Red
4	Safe conditions	Green

Attachment -5 Safe Work Procedure for Work Near Railway Track

- 1.0 Safety precautions and measures to be observed during execution of ROB/ RUB/ Viaduct/ any other works in Railway and adjoining areas:
- 1.1 The Contractor(s) shall not allow any road vehicle belonging to him or his suppliers, etc. to ply in HRIDC/railway land next to the running line. If for execution of certain works viz. earthwork for parallel railway line and supply of ballast for new or existing rail line gauge conversion, etc. road vehicles are necessary to be used in railway/HRIDC land next to the railway line, the Contractor(s) shall apply to the Engineer-in-Charge for permission giving the type and number of individual vehicles, names and license particulars of the drivers, location, duration and timings for such work/movement. The Engineer-in-Charge or his authorized representative will personally counsel, examine and certify the road vehicle drivers, Contractor(s)' flagmen and supervisors and will give written permission giving names of road vehicle drivers, Contractor(s)' flagmen and supervisors to be deployed on the work, location, period and timing of the work. This permission will be subject to be following obligatory conditions:
- 1.2 Construction Activities and Safety:**
- a) The 'Methodology of Working' shall be incorporated in GAD and Temporary Arrangement Drawings.
 - b) The activities of work to be taken up during the railway traffic block/under speedrestriction, etc. should be clearly mentioned in such drawings. If at any stage of execution, any discrepancy is found in the drawing with respect to the site condition affecting safety or some new activity of work is required to be done, the same should be brought to the notice of Railway & HRIDC Engineers and such works should be done only after approval by Railways & HRIDC representative. In such cases, the scheme may be modified and, if required, fresh CRS sanction shall have to be obtained.
- 1.2.1 The works required to be done under traffic block protection are to be carried out only in the presence of Railway & HRIDC Engineering Officials. The Railway's and HRIDC's Supervisor has to certify safe conditions for passage of trains before resumption of traffic. The works to be done under traffic shall be carried out under the provision of banner flag and protection by Engineering Flagman.
- 1.2.2 Following important activities of works shall be carried out under supervision of Railway/HRIDC Engineer or his nominated Supervisor:
- a) Excavation at foundation/ground level near to railway track
 - b) Concrete casting and/or masonry work very close to railway track
 - c) Erection of temporary structures near to running lines.
 - d) Casting of structures like girder/slab over railway track
 - e) Stage-prestressing of girders when placed across railway tracks properly supported
 - f) Launching of precast/pre-assembled girders across railway tracks
 - g) Any work of lifting, side shifting and slewing of girders over the railway track
 - h) Dismantling of temporary structures, shuttering, scaffolding, etc. adjacent to and above the railway track. For carrying out activities of casting, erection, launching, handling, and dismantling as listed above, the Contractor's Engineer shall furnish the Construction Programme in advance to HRIDC Supervising Engineer & Engineer representative. No such work should be taken up in the absence of the HRIDC Supervising Engineer & Engineer representative. For the activities which are to be done in presence of the HRIDC Engineer and prior intimation shall be given in writing and acknowledgement obtained from HRIDC's representative.

- 1.2.3 To ensure 'Safety' during construction activities, HRIDC Site Engineer & Engineer representative may direct the Contractor's Supervisor/Engineer or their nominated representative for safe working procedures/ instructions, notwithstanding the contractual or MOU conditions prevailing between/ among Railways/other Departments like NHAI/Contractors/ Concessionaire.
- 1.2.4 All the records of Quality Assurance/Quality Control, testing of the materials and satisfactory completion of an activity shall be maintained at site by the Contractor's Engineer and Supervisor. On the basis of these records, HRIDC Site Engineer shall do stage-wise clearance of the works at following stages:
- i) Completion of foundation
 - ii) Completion of substructure
 - iii) Completion of superstructure

Without such stage clearance, the work in the next stage of construction shall not be allowed by the HRIDC Supervisor, unless proper system of check and exercise is followed at the site.

- 1.2.5 Normally, the high beam PSC girders are designed with wider top flange and shorter bottom flange with very high beam which makes the girder unsuitable during lowering, slewing and launching time.
- 1.2.6 During launching of girders and subsequent adjustments for placement of bearing, special attention and precautions are required at site to be followed rigorously without resorting to shortcut practice or leaving the work at site to untrained or inexperienced Engineers. Normally, end diaphragms are not cast for the extreme both side girders. These shall be cast minimum 300mm on both sides for all 'I' beam girders to provide temporary supports for ensuring stability.

"OR"

For side adjustments and bearing placements below 'I' section girders, end brackets made of steel angles should be provided for all 'I' beams sequentially to avoid side titling of individual girders. End brackets shall be removed only after placing girders on bearing and casting of diaphragms.

- 1.2.7 During lowering, the jacks shall be operated duly keeping wooden packing of various thicknesses fixing the amount of lowering to the barest minimum, so that even if the jack fails, the wooden packing will take load and further stability of girder is not endangered.
- 1.2.8 Temporary crib support staging shall be interlaced with clamps and angles. Adequate base width shall be maintained proportionate to the height of stage, which is very essential for avoiding the oblong effect during launching of girders. During launching by RH girder method, the movement of the PSC girders shall be controlled both from front and rear with sync mechanism having simultaneous operation, so that the speed of the launching is always under control. Spare hydraulic jacks shall always be kept at site. Lowering of girder shall always be carried out at one end only. Further, the other end should be adequately secured by wire ropes, end brackets, etc. Thereafter, the process shall be continued alternately.
- 1.2.9 As far as possible, launching of girders by temporary staging shall be avoided and launching by heavy capacity cranes, wherever feasible, shall be adopted.
- 1.2.10 Steel girder launcher if used for launching of PSC girders should be pre-tested for the critical loading (likely to be encountered during actual launching) before deployment on the approaches regarding its strength as well as amount of permissible deflection using actual test PSC girder as a testing load. Connections at supports shall be inspected and

certified prior to actual launching. It shall be adequately secured to the base support system on the pier cap.

1.3 General Construction Safety:

- 1.3.1 General safety precautions as applicable for civil works shall be adopted in field.
- 1.3.2 Working near running line: Safe practices at site and at all times non-infringement to moving trains shall be ensured. Road vehicles, material trolleys, dollies with any tendency to roll off towards the running lines to be checked by providing chains, locking arrangements, blocks, etc. shall be ensured and the Site-in-Charge of the Contractor shall be primarily responsible, secondary responsibility being of Contractor's Consultant.
- 1.3.3 Testing of cranes, lifting jacks and other equipment: All equipment like cranes, lifting jacks shall be tested, duly calibrated and certified prior to use at the construction site.
- 1.3.4 Routine safety checks, validity of test certificates for load bearing equipment especially for cranes outsourced from third party shall be ensured prior to deployment.
- 1.3.5 Construction workers at site shall be provided with personal safety gear like reflective vest, helmet, Safety shoes, gloves & eyewear approved as per construction industry standards. For persons working at pier top/girder level, temporary supports, hand railing, protection with help of ropes, slings and temporary railings shall be provided.

2.0 Safety Guidelines and Precautions for working close to Railway tracks.

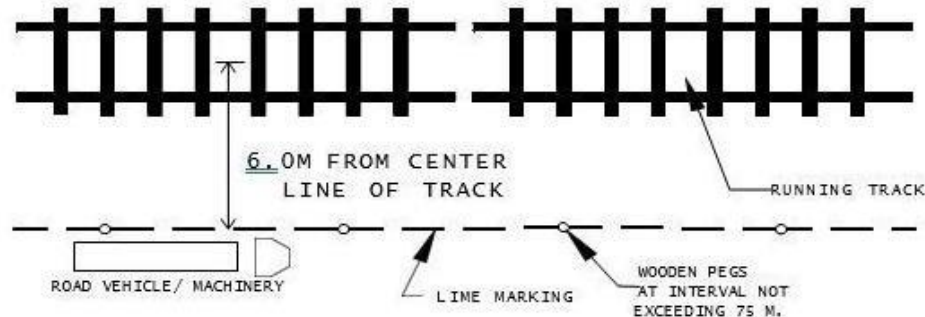
2.1 A large number of men and machinery are deployed by the contractors for track renewals, gauge conversions, doublings, bridge rebuilding etc. It is therefore essential that adequate safety measures are taken for the safety of the trains as well as the workforce. The following measures should invariably be adopted.

- A. The contractor shall not start any work without the presence of the HRIDC Engineer at site.
- B. Wherever the road vehicles and/or machinery are required to work in the close vicinity of railway line, the work shall be so carried out that there is no infringement to the Railway's schedule of dimensions. For this purpose, the area where road vehicles and/or machinery are required to ply, shall be demarcated, and acknowledged by the contractor. Special care shall be taken for turning/ reversal of road vehicles/machinery without infringing the running track. Barricading shall be provided wherever justified and feasible as per site conditions.
- C. The look out and whistle caution orders should be issued to the trains and speed restrictions imposed where considered necessary. Suitable flagmen/detonators shall be provided where necessary for protection of trains.
- D. The supervisor/workmen should be counseled about safety measures. A competency certificate to the contractor's supervisor as per Performa annexed shall be issued by DGM/HRIDC, which will be valid only for the work for which it has been issued.
- E. The unloaded ballast/rails/sleepers/other P-Way materials after unloading along track should be kept clear off moving dimensions and stacked as per the specified heights and distance from the running track.
- F. Supplementary site-specific instructions, wherever considered necessary, shall be issued by the HRIDC's representative.

2.2 PLYING OF ROAD VEHICLES AND WORKING OF MACHINERIES CLOSE TO RUNNING TRACKS

- A. Normally, the road vehicles shall be run, or machinery shall be worked so as not to come closer than 6.0m from center line of nearest running track.
- B. The land strip adjacent to running tracks, where road vehicles are to ply or machinery is to

work, shall be demarcated by lime in advance in consultation with the Railway's & HRIDC's Engineer. Wooden pegs at interval not exceeding 75mtr. shall be provided along the line marking as permanent marks. The road vehicles shall ply or machinery shall work so as not to infringe the line of demarcation.



C. If a road vehicle or machinery is to work closer to 6.0m due to site conditions or requirement of work, following precautions shall be observed:

- a) In no case the road vehicle shall run, or machinery shall work at distance less than 3.5m from center line of track.
- b) Demarcation of land shall be done by bright colored ribbon/nylon cord suspended on 120 cm high wooden/bamboo posts at distance of 3.5 m from center line of nearest running track.
- c) The presence of an authorized HRIDC's representative shall be ensured before plying of vehicle or working of machinery.
- d) Railway's Supervisor shall issue suitable caution order to Drivers of approaching train about road vehicles plying or machineries working close to running tracks. The train drivers shall be advised to whistle freely to warn about the approaching train. Whistle boards shall be provided wherever considered necessary.
- e) Lookout men shall be posted along the track at a distance of 800m from such locations who will carry red flag and whistles to warn the road vehicle/machinery users about the approaching trains.
- f) On curves where visibility is poor, additional lookout men shall be posted.

D. If vehicle/machinery is to be worked closer to 3.5m from running track - Under unavoidable conditions, if road vehicles is to ply or machinery is to work closer to 3.5m due to site conditions or requirement of work, following precautions shall be observed:

- a) Plying of vehicles or working of machinery closer to 3.5m of running track shall be done only under protection of track. Traffic blocks shall be imposed wherever considered necessary. The site shall be protected as per the provisions of Para No. 806 & 807 of P-Way Manual as case may be.
- b) The presence of a Railway's/, HRIDC's Supervisor shall be ensured at worksite.
- c) Railway's& HRIDC's Supervisor shall issue suitable caution order to Drivers of approaching train about road vehicles plying or machinery working close to running tracks. The train drivers shall be advised to whistle freely to warn about the approaching train.

E. Precaution to be taken while reversing road vehicle alongside the track

The location where vehicle will take a turn shall be demarcated duly approved by Railway's/HRIDC's representative. The road vehicle driver shall always face the Railway

track during the course of turning/reversing his vehicle. Presence of an authorized Railway/HRIDC representative shall be ensured at such location.

- F. Road vehicle shall not be allowed to run along the track during night hours generally. In unavoidable situations, however, vehicles shall be allowed to work during night hours only in the presence of an authorized Railway's/HRIDC's representative and where adequate lighting arrangements are made and where adequate precautions as mentioned earlier have been ensured.
- G. Road vehicles/machinery/plant etc. when stabled near running tracks shall be properly secured against any possible roll off and always be manned even during off hours.

2.3 EXECUTION OF WORKS CLOSE TO OR ON RUNNING LINES

- A. **Any work close to or on running tracks shall be executed under the presence of a HRIDC's Supervisor only.**
- B. **Precautions to be taken to ensure safety of trains while execution of work close to the running line or on running lines.**
 - a) Such works shall be planned and necessary drawings particularly with regard to infringement to moving dimensions shall be finalized duly approved by competent authority before execution of work. The work shall be executed only as per approved procedure and drawings.
 - b) All temporary arrangements required to be made during execution of work shall be made in such a manner that moving dimensions do not infringe.
 - c) Suitable speed restriction shall be imposed, or Traffic block shall be ensured as required. *The requirement of Traffic and Power Blocks shall be submitted by the Contractor to the Engineer for approval. The Traffic and Power Blocks will be finalized in consultation with Delhi Division of Northern Railway. No cost shall be charged for Traffic and Power Blocks from the Contractor.*
 - d) Necessary equipment for safety of trains during emergency shall be kept ready at site.
- C. **Precautions to be taken to ensure safety of electrical/signal/ telephone cables while excavating near tracks.**
 - a) Particular care shall be taken to mark the locations of buried electrical/signal/telephone cables on the plans jointly with S & T/Electric supervisor and also at site so that these are not damaged during excavation.
 - b) Copy of the cable plan should be given to the contractor's authorized representative before handing over the site to start the work.
 - c) Due care shall be taken to ensure that any part of the equipment or machinery or temporary arrangement does not come close to cables while working.
 - d) Joint procedure order No. 17/2013 issued by Railway Board vide letter No.2003/Tele/RCIL/1 Pt IX dated 24.06.2013 shall be followed for undertaking digging work in the vicinity of underground signaling, electrical and telecommunication cables.
- D. **Precautions to be taken during execution of works requiring traffic blocks.**
 - a) Any work which infringes the moving dimensions shall be started only after the traffic block has been imposed.
 - b) Before closing the work, the track shall be left with the proper track geometry so that the trains run safely.
 - c) After completion of work the released sleeper and fittings should be properly stacked

away from the track to be kept clear of moving dimensions.

- d) Block shall be removed only when all the temporary arrangement, machineries, tools, plants etc. have been kept clear of moving dimensions.

E. Precaution to be taken during execution of works during night:

The work close to the running line, generally, shall be carried out only during day hours. At locations, however, where night working is unavoidable, proper lighting arrangement should be made. The engineering indicator boards shall be lighted during night hours as per the provisions of IRPWM. The staff deputed for night work should have taken adequate rest before deploying them in night shift. We can specify the duration of night shift from 20.00 hrs to 04.00 hrs. All other safety precautions applicable for daytime work should be strictly observed during night working.

F. Precautions to be taken to ensure safety of workers while working close to running lines:

- a) Necessary lookout men with red flags and whistles shall be provided to warn the workmen about the approaching train.
- b) Railway's/HRIDC's supervisor shall issue suitable caution order to Drivers of approaching train for whistling to warn the workers about the approaching train. Whistle boards shall be provided wherever considered necessary.
- c) A "First aid kit" shall always be kept ready at site

G. Precautions shall be taken for safety of public or passengers, while executing works at locations, used by passengers and public.

The worksite shall be suitably demarcated to keep the public and passengers away from the work area. Necessary signage boards such as "Work in progress. Inconvenience is regretted" etc. shall be provided at appropriate locations to warn the public/ passengers. Adequate lighting arrangement of worksite wherever required shall be done to ensure safety of public/passengers during night.

H. Precaution to be taken before stacking materials alongside the track to ensure that safety of trains is not affected –

The following precautions shall be taken before stacking the materials along the track for stacking of ballast, rails, sleepers etc.

- a) The sites for material stacking should be selected in advance in such a manner as to ensure that no part of the material to be stacked is infringing the Standard Moving Dimensions. A plan of proposed stacking locations be made and signed jointly by an authorized HRIDC's/Railway's representative and contractor's representative.
- b) The selected locations shall be marked by lime in advance.
- c) The presence of an authorized HRIDC's/Railway's representative while unloading and stacking shall be ensured.
- d) The material shall be stacked at such a height so as to not to infringe SOD in case of accidental roll off.

I. Precaution for handling of departmental material trains –

Instructions for the working of material trains are contained in Chapter VIII of IRPWM which should be brought to the notice of the supervisors and other staff working on the material trains. In addition to this, following precautions should be taken:

- a) Issue of 'fit to run' certificate:

As per Para 848 before a material train is allowed to work, the complete rake should be examined by the Carriage and Wagon staff and a 'fit to run' certificate issued to the

Guard.

- b) As per Para 849 of IRPWM, a qualified Engineering official should be deputed on the train to ensure the working of the material train as the Guard is not qualified to carry out such duties like Supervising of loading and unloading of materials.
- c) As per Para 845 of IRPWM, the material train should not be permitted to work during the period of poor visibility due to fog, storm or any other cause except with the permission of the ADEN/DEN. Working of the material trains carrying labour should not be permitted between sunset and sunrise except in an emergency.
- d) While unloading rail panels by the side of the running track, placement of the panels, clear of the maximum moving dimensions should be ensured.
- e) The unloading of rail panels should be done by a team of trained staff under the active supervision of a competent Supervisor/Officer.
- f) Before unloading of rail panels, site should be prepared by way of leveling/removing extra ballast, if any, from the crib and shoulder with the objective to ensure requisite lateral and vertical clearances so as to prevent slippage of rail panels due to vibration during the passage of trains.
- g) Reasonably adequate block should be asked for and provided for unloading of the material and the work should be done preferably in daylight to avoid shortcut in haste which may infringe the safety requirements.

J. Safety aspects to be observed while working in OHE area.

- a) No electrical work close to the running track shall be carried out without permission of HRIDC representative.
- b) A minimum distance of 2m has to be maintained between live OHE wire and the bodypart of worker or tools or metallic supports etc.
- c) No electric connection etc. can be tapped from OHE.
- d) Authorized OHE staff should invariably be present when the relaying work or any major work is carried out.
- e) Power block is correctly taken and 'permit to work' is issued.
- f) The structure bonds, track bonds, cross bonds, longitudinal rail bonds are not disturbed and if disconnected for the work, they are reconnected properly when the work is completed.
- g) The track level is not raised beyond the permissible limit during the work.

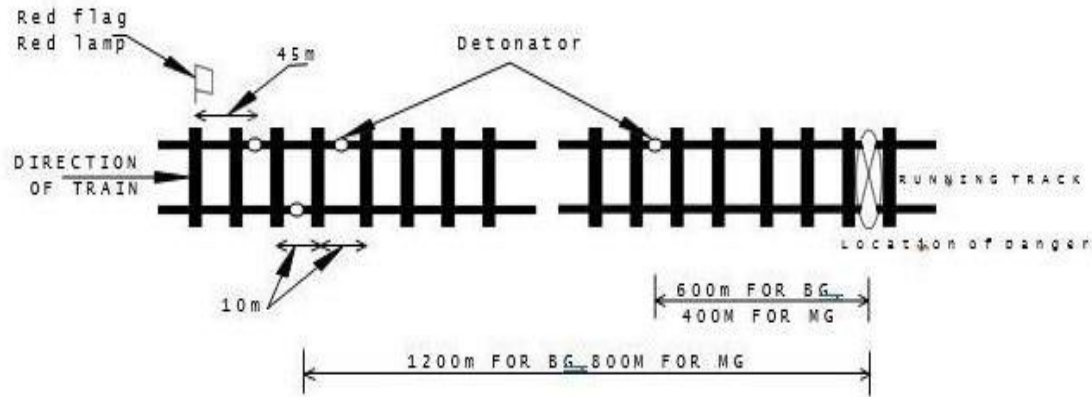
2.4 PROTECTION OF TRACK DURING EMERGENCY

A. Action to be taken when a contractor's supervisor or vehicle operator apprehends any unusual circumstances likely to infringe the track and endanger the safe running of trains.

- a) At any time if a contractor's supervisor or vehicle operator observes any unusual circumstances likely to infringe the track and apprehend danger to safe running of track, he shall take immediate steps to advise a HRIDC official of such danger and assist him in protection of track.
- b) The track shall be protected as under. One person shall immediately plant a red flag (red lamp during night) at the spot and proceed with all haste in the direction of approaching train with a red flag in hand (red lamp during night) and plant a detonator on rail at a distance of 600m from the place of obstruction of BG track (400m for MG track) after which he shall further proceed for not less than 1200m from the place of obstruction from BG track (800m for MG track) and plant three detonators at 10m apart

on rails. After this he shall display the red flag (red lamp during night) at a distance of 45m from the detonators.

- c) Attempts shall also be made to send an advice to the nearest Railway/HRIDC station about the incident immediately.



B. Action to be taken if train is seen approaching to site of danger and there is no time to protect the track as per guidelines mentioned above.

In such a case the detonators shall be planted on rails immediately at distance away from place of danger as far as possible and attention of driver of approaching train shall be invited by whistling, waving the red flag vigorously, gesticulating and shouting.

C. What action shall be taken if more than one track is obstructed.

- In case of single line protection as above shall be done in both the directions from place of danger.
- In case of double line or multiple lines, if other tracks are also obstructed, the protection as above shall be done for other track also.
- The protection shall be done in that direction and on that track first on which train is likely to arrive first.
- The Contractor's Supervisors, Operators and lookout men shall be properly explained about the direction of trains on running tracks.

D. Equipment required for protection of track.

Minimum compliment of protection equipment i.e. 10 detonators, 4 red hand flags, 4 red hand lamps, 4 banner flags and whistles etc. shall always be kept ready at worksites for use in case of emergency. HRIDC will arrange to provide detonators, whereas Contractor shall arrange other equipment at his own cost.

E. Arrangement of lookout men and competency required for lookout man to warn labour about approaching train.

- Contractor will provide lookout men.
- The lookout men shall be properly trained in warning to staff at worksite about approaching train.
- Only those lookout men shall be provided at site who have been issued with a competency certificate by the Railway's/HRIDC's Supervisor.
- In case, it is felt necessary to provide lookout men by Contractor, the charges for

the same as fixed by HRIDC Administration shall be recovered from Contractor.

2.5 Training to Supervisors and Operators of Contractor

The Supervisors and Operators of the contractor proposed to be deployed at wok site, which is close to the running track, shall be imparted mandatory training by the HRIDC at site free of cost about the safety measures to be adopted while working in the vicinity of running track. HRIDC’s Engineer-in charge of the work shall decide the scale, extent & adequacy of training. In case training is imparted at a recognized Railway training institute, the charges for the same, as decided by HRIDC, shall be recovered from the Contractor. A competency certificate to this effect to the individual Supervisor/Operator shall be issued as given below,by a HRIDC Officer not below the rank of DGM/HRIDC. No Supervisor/Operator of the Contractor shall work or be allowed to work in the vicinity of a running track that is not in possession of valid competency certificate.

All the labour, materials, tools, plants etc. except detonators, required for ensuring the safe running of trains shall be provided by Contractor at his own cost. Wherever lookout men are provided by HRIDC, charges at the rate of Rs. 1000/- per man day shall be recovered from Contractor.

A sample of training competency certificate is provided below for reference:

<p>Competency Certificate</p> <p>Certified that Shri Supervisor/Operator of M/s.has been trained and examined in safety measures to be followed while working in the vicinity of running railway track for the work. His knowledge has been found satisfactory and he is capable of supervising the work safely.</p> <p>This certificate is valid only for the work mentioned in this certificate only.</p> <p style="text-align: right;">Signature and designation of the officer</p>

***Final* Tender Document for Works**

(Two-Envelope Tendering Process Without Prequalification)

Procurement of:

Contract Package SYS-1: Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km (-)2.099 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 315 TKM).

Summary

Specific Procurement Notice (SPN)

PART 1 – TENDERING PROCEDURES

- Section I - Instructions to Tenderers (ITT)
- Section II - Tender Data Sheet (TDS)
- Section III - Evaluation and Qualification Criteria
- Section IV - Tender Forms
- Section V - Eligible Countries
- Section VI - Prohibited Practices

PART 2 – EMPLOYER’S REQUIREMENTS

- Section VII - Employer’s Requirements

PART 3 – CONDITIONS OF CONTRACT AND CONTRACT FORMS

- Section VIII - General Conditions of Contract (GCC)
- Section IX - Particular Conditions of Contract (PCC)
- Section X - Contract Forms

PART 3 – Conditions of Contract and Contract Forms

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Section VIII - General Conditions of Contract (GCC)

The General Conditions of Contract governing this Contract shall be the “Conditions of Contract for Plant & Design Build, (“Yellow book, Second Edition 2017”, published by the Federation Internationale Des Ingenieurs – Conseils (FIDIC).

An original copy of the above FIDIC publication i.e. “*Conditions of Contract for Plant & Design Build*”, (“Yellow book , Second Edition 2017”, (must be obtained from the following address of FIDIC:

International Federation of Consulting Engineers (FIDIC)

FIDIC Bookshop – Box- 311 – CH – 1215 Geneva 15 Switzerland

Fax: +41 22 799 49 054

Telephone: +41 22 799 49 01

E-mail: fidic@fidic.org

www.fidic.org

FIDIC code: ISBN13: 978-2-88432-084-9

Section IX - Particular Conditions of Contract (PCC)

The following Particular Conditions of Contract (PCC) shall supplement the GCC. Whenever there is a conflict, the provisions herein shall prevail over those in the GCC.

The PCC consists of three parts:

- Part A – Contract Data
- Part B – Specific Provisions
- Part C – Prohibited Practices

The references to Clauses and Sub-clauses provided in the PCC given below are applicable to the General Conditions of Contract i.e. “Conditions of Contract for Plant & Design Build, (“Yellow Book”), Second Edition 2017” published by the Federation Internationale Des Ingenieurs – Conseils (FIDIC).

Particular Conditions of Contract (PCC)

Part A - Contract Data

S. No.	Conditions	GCC Sub-Clause	Data
1.	Defects Notification Period	1.1.27	1095 days calculated from the date of issue of Taking-Over Certificate for the Works or part of the Works.
2.	Employer's name and address	1.1.30	Haryana Orbital Rail Corporation Limited (HORCL), Plot No 143, 5th Floor, Railtel Tower, Sector-44, Gurugram, Haryana-122003 E-mail: vikramyadav.hridc@gmail.com
3.	Engineer's name and address	1.1.35	RITES Limited in Consortium with SMEC International Pty Ltd, 4th Floor, Plot No.144, RITES Limited, Sector-44, Gurugram, Haryana-122003
4.	Sections	1.1.76	<i>Refer Table 2 given at the end of Part A-Contract Data, Section IX PCC.</i>
5.	Time for Completion	1.1.86	1460 days
6.	Bank's name	1.1.91	Asian Infrastructure Investment Bank (AIIB)
7.	Borrower/Recipient's name	1.1.92	Haryana Orbital Rail Corporation Limited (HORCL) through Government of Haryana
8.	Electronic transmission system	1.3 (a) (ii)	By e-mail
9.	Address of Employer for communications:	1.3(d)	Plot No 143, 5th Floor, Railtel Tower, Sector-44, Gurugram, Haryana-122003 E-mail: vikramyadav.hridc@gmail.com
10.	Address of Engineer for communications:	1.3(d)	4th Floor, Plot No.144, RITES Limited, Sector-44, Gurugram, Haryana-122003
11.	Address of Contractor for communications:	1.3(d)	To be filled in at the time of preparation of Contract Agreement
12.	Governing Law	1.4	The laws of Republic of India
13.	Ruling language	1.4	English
14.	Language for communications	1.4	English

S. No.	Conditions	GCC Sub-Clause	Data
15.	Time for the Parties to sign a Contract Agreement	1.6	35 days after issue of the Letter of Acceptance
16.	Number of additional paper copies of Contractor's Documents	1.8	NIL
17.	Total liability of the Contractor to the Employer under or in connection with the Contract	1.15	Equal to the Accepted Contract Amount
18.	Time for access to the Site	2.1	Access to Site shall be provided as per Table: Time for Access to Site given at the end of Part A-Contract Data.
19.	Employer's Financial Arrangements	2.4	A loan from AIIB Bank and counterpart funds through equity partners.
20.	Engineer's Duties and Authority	3.2	Cumulative variations resulting in an increase of the Accepted Contract Amount in excess of 5% shall require written consent of the Employer.
21.	Performance Security	4.2	The Performance Security will be in the form of a "demand guarantee" in the amount(s) of 5% of the Accepted Contract Amount and in the same currency (ies) of the Accepted Contract Amount. Demand guarantee for the Performance Security shall be in the form as specified in Sub-Clause 4.2, Part B-Specific Provisions, PCC.
22.	Maximum allowable accumulated value of work subcontracted (as a percentage of the Accepted Contract Amount)	4.4(a)	10%
23.	Parts of the Works for which subcontracting is not permitted	4.4(b)	NIL
24.	Period for notification of errors in the items of reference	4.7.2 (a)	28 Days
25.	Number of additional paper copies of progress reports	4.20	One (1)
26.	Normal working hours	6.5	From 8:00 AM to 5:00 PM
27.	Number of additional paper copies of program	8.3	One (1)

S. No.	Conditions	GCC Sub-Clause	Data
28.	Delay Damages payable for each week of delay or part thereof	8.8	<p>0.05% of the Accepted Contract Amount, less Provisional Sum in the currencies and proportions in which the Contract Price is payable for each week or part thereof which shall elapse between the Time for Completion and actual Date of Completion of the Works.</p> <p><i>0.05% of the Accepted Contract Amount, less Provisional Sum in the currencies and proportions in which the Contract Price is payable for each week or part thereof which shall elapse between the Time for Completion and actual Date of Completion of the Works of Sections as per Table 2.0: Sections for Taking Over of the Works” in Section IX Particular Conditions of Contract (PCC), Part A-Contract Data.</i></p>
29.	Maximum amount of Delay Damages	8.8	5% of the Accepted Contract Amount, less Provisional Sum.
30.	Percentage rate to be applied to Provisional Sums for overhead charges and profit	13.4(b)(ii)	5%

S. No.	Conditions	GCC Sub-Clause	Data
31.	Total advance payment	14.2	<p>05% of the Accepted Contract Amount less Provisional Sum payable in the currencies and proportions in which the Accepted Contract Amount is payable.</p> <p>The advance payment shall be released against Advance Bank Guarantee in two equal instalments, each of two and half percent (2.5%), of the Accepted Contract Amount less Provisional Sum payable in the currencies and proportions in which the Accepted Contract Amount is payable.</p> <p>i. The first instalment shall be paid against an Advance Payment Certificate, under Sub-Clause 14.2.2.</p> <p>ii. Upon satisfactory utilization of first instalment, the second instalment shall be paid after the Engineer's approval of the Programme (GCC Sub-Clause 8.3), mobilization of Contractor's Representative (GCC Sub-Clause 4.3) and Key Personnel (GCC Sub-Clause 6.12) as per the Employer's Requirements. The Contractor shall submit utilization statement mentioning detailed particulars of expenses made with supporting documents to demonstrate that such amounts are utilized in a purposeful manner in relation to the Works. This shall be supported or endorsed by certified Chartered Accountant under their seal and stamp. It shall be paid against an Advance Payment Certificate, under Sub-Clause 14.2.2.</p>
32.	Number of additional paper copies of Statements	14.3(b)	One (1)
33.	Percentage of retention	14.3 (iii)	10%
34.	Limit of Retention Money (as a percentage of Accepted Contract Amount less Provisional Sum)	14.3 (iii)	5%

S. No.	Conditions	GCC Sub-Clause	Data
35.	Plant and Materials	14.5(b)(i)	Plant and Materials for payment when shipped - NIL
		14.5(c) (i)	Plant and Materials for payment when delivered to the Site: NIL
36.	Minimum Amount of Interim Payment Certificates	14.6.2	NIL
37.	Period of payment of Advance Payment to the Contractor	14.7(a)	07 days
38	<i>Percentage value of a Section</i>	<i>14.9</i>	<i>Refer Table 2 given at the end of Part A-Contract Data, Section IX PCC.</i>
39..	Delayed Payment	14.8	The financing charges shall be calculated at an interest rate equal to “State Bank of India’s (SBI) Marginal Cost of fund-based Lending Rate (MCLR)” applicable for the tenure of 01 year prevailing on the due date plus three percent.
40.	Number of additional paper copies of draft Final Statement	14.11.1(b)	Two (2)
41.	Forces of nature, the risks of which are allocated to the Contractor	17.2(d)	Earthquake, Floods, rain, wind/storm
42.	Periods for submission of evidence(s) and relevant policy (ies) of insurance (s)	19.2	Evidence(s): Within twenty-eight (28) days from Commencement Date Notice. Policy(ies): Within forty-two (42) days from Commencement Date Notice.
43.	List of Exceptional Risks which shall not be excluded from the insurance cover for the Works	19.2.1 (iv)	Earthquake, Floods, Rain, wind/storm

S. No.	Conditions	GCC Sub-Clause	Data
44.	Liability for breach of professional duty	19.2.3	<p>AOA (Any One Accident) limit equal to four percent (4%) of the total Contract value against Schedule 'A' of Price Schedule in respect of 'design and construct' with AOY (any one year) limit of 2 accidents in a year. In the Professional Indemnity Insurance Policy, the deductible amount shall not be more than five percent (5%) of the AOA limit.</p> <p>This PII policy shall be valid from the date of commencement of Works, until 5 years after the date of issue of Performance Certificate. Alternatively, the Contractor shall renew the insurance before the expiry of the Yearly Insurance in such a way that the entire validity period is covered.</p> <p>Wherever the Contractor submits policy for shorter period / annual renewable policy, the same shall be renewed before its expiry date. In such situation, the Performance Guarantee shall be retained till required validity period. The Contractor's submission of such shorter period / renewable policy shall be construed as their irrevocable consent for retention of the Performance Guarantee. The Engineer will not issue Final Payment Certificate until the Contractor has produced evidence that coverage of the professional indemnity insurance has been provided for the aforesaid period.</p>
45.	Amount of insurance required for injury to persons and damage to property	19.2.4	INR 0.50 million for any one incident, with number of incidents unlimited
46.	Insurance required for injury to employees	19.2.5	INR 20,000,000/- (Twenty million)
47.	Time for appointment of DAAB	21.1	Within 60 days of request of either Party for appointment of DAAB

S. No.	Conditions	GCC Sub-Clause	Data
48.	The DAAB shall be comprised of	21.1	Three Members
49.	List of proposed members of DAAB	21.1	NIL
50.	Appointment (if not agreed) to be made by	21.2	(i) In case of Indian firms- President of Indian Council of Arbitration, New Delhi, India (ii) In case of foreign firm- Singapore International Arbitration Centre (SIAC).
51.	Rules of arbitration	21.6	Sub-Clause 21.6 of PART B – Specific Provisions shall apply.

**Table – 1.0: Time for Access to Site
(Sub-Clause 2.1)**

The Access Schedule for Package SYS-1 shall be as under:

A: TSS/SP/SSP land:

S. No.	Installation Name	Installation Type	Date of Access	
			Start	Finish
1.	Manesar	SSP	D+30	
2.	Chandla Dunderwas	TSS	D+210	
3.	Mandothi	TSS		
4.	Prithla	SP		
5.	Sohna	SSP		
6.	Dhulawat	SSP		
7.	Badsa	SP		
8.	Badli	SSP		
9.	Jasaur Kheri	SSP		
10.	New Harsana Kalan	SP		
11.	Sultanpur	SP		
12.	Asaudah	SP		

B: OHE and ROCS works:

S. No.	Civil Contract Package	Chainage km	Date of Access	
			Start	Finish
1	C-1	49.70 to 55.60	D+90	D+180
2	C-23	55.60 to 59.00	D+240	D+360
3	C-23	Connectivity Patli to New Patli and New Patli to Sultanpur	D+330	D+420
4	C-23	29.14 to 49.70	D+450	D+600
5	C-23	59.00 to 61.50	D+450	D+550
6	C-5	(-)2.11 to 24.40	D+600	D+1100
7	C-6	61.50 to 125.98 and Badsa to Sultanpur connectivity	D+720	D+1100

S. No.	Civil Contract Package	Chainage km	Date of Access	
8	C-6	Connectivity to Asaudah	D+720	D+1100
9	C-6	Connectivity to Harsana Kalan	D+720	D+1100
10	C-4	24.40 to 29.14 (Tunnel-1)	D+1000	D+1100
11	C-4	24.40 to 29.14 (Tunnel-2)	D+1300	D+1350

Notes:

1. D stands for “Commencement Date” of the Contract SYS-1.
2. The access for OHE works will be provided in a stretch of 1.5 to 3 km each. Further, access will be provided gradually in phases.

**Table 2.0 Sections for Taking Over of the Works
(Ref. Sub-Clause No. 1.1.76 and 10.1 of GCC)**

S. No.	Section	Contract Package	Approximate Chainage	Time for Completion of Sections from the Commencement Date	Percentage value of the Section (Ref. Sub-Clause 14.9 of GCC)
1.	Section 1	C-1 and C-23	(i) Main Line Ch. Km 32.00 to Ch.km 59.00 including New Patli station. (ii) Connectivity Line – a. New Patli to Patli b. New Patli to Sultanpur including Sultanpur station (iii) Completion of SCADA works in OCC Manesar	600	30% (Thirty percent) of “Accepted Contract Amount less Provisional Sum”
2.	Section 2	C-23, C-4 and C-5	Main Line – Ch. Km (-) 2.12 to Ch. Km 32.00 including Tunnel 1(Ch.km 24.850 to Ch.km 29.580)	1100	20% (Twenty Percent) of “Accepted Contract Amount less Provisional Sum”
3.	Section 3	C-23 and C-6	(i) Main Line – Ch. Km 59.00 to Ch. Km 109.330 including Kharkhoda station, (ii) Connectivity Line – a. Badsa-Sultanpur b. Mandothi-Asaudah	1300	40% (Forty Percent) of “Accepted Contract Amount less Provisional Sum”
4.	Section 4	C-6	Main line Kharkhoda Station (Excl.) to Harsana Kalan (Incl.) from Ch. Km 109.408 to Ch. Km 125.813	1300	9% ((Nine Percent) of “Accepted Contract Amount less Provisional Sum”
5.	Section 5	C-4	Tunnel 2 (Ch.km 24.850 to Ch.km 29.580)	1500	1% (One percent) of “Accepted Contract Amount less Provisional Sum”

Note: 1. Sections shall be considered complete for Taking Over when all the Works within the geographical Chainages are completed.

Particular Conditions of Contract (PCC)

Part B - Specific Provisions

Sub-Clause 1.1.9 Contract	“the Contractor’s Proposal” is deleted.
Sub-Clause 1.1.27 "Defects Notification Period" or "DNP"	Add the following at the end of Sub-Clause 1.1.27 "Defects Notification Period" or "DNP" is synonymous with "Defects Liability Period" or "DLP"
Sub-Clause 1.1.28 "Delay Damages"	Add the following at the end of Sub-Clause 1.1.28 "Delay Damages" is synonymous with “Liquidated Damages”.
Sub-Clause 1.1.30 Employer	The following is added at the end of this Sub-Clause: Haryana Rail Infrastructure Development Corporation Limited (HRIDC) has been nominated as the implementing agency for Haryana Orbital Rail Corridor (HORC) Project by the Employer i.e. Haryana Orbital Rail Corporation Limited.
Sub-Clause 1.1.49 Laws	The Sub-Clause is replaced with: “ Laws ” means all national (or state) legislation, statutes, ordinances and other laws, and regulations and by-laws of any legally constituted public authority.”
Sub-Clause 1.1.77 Site	The Sub-Clause is replaced with: “ Site ” means the places where the Permanent Works are to be executed, including storage and working area, and to which Plant and Materials are to be delivered, and any other places specified in the Contract as forming part of the Site.”
Sub-Clause 1.1.79 Statement	On the second line after “Payment Certificate under...”, add “Sub-Clause 14.2.1 [Advance Payment Guarantee] (if applicable).”.
Sub-Clause 1.1.83 Tender	“the Contractor’s Proposal” is deleted.
Sub-Clause 1.1.86 Time for Completion	Replace the entire Sub-Clause 1.1.84 with the following: “ Time for Completion ” means the time for completing the Works, a Section (as the case may be) or a Key Date (as the case may be) under Sub-Clause 8.2 [Time for Completion], as stated in the Contract Data (with any extension under Sub- Clause 8.5 [Extension of Time for Completion]), calculated from the Commencement Date

Sub-Clause 1.1.91 to 1.1.98 are added after Sub-Clause 1.1.90	
Sub-Clause 1.1.91 Bank	“ Bank ” means the financing institution (if any) named in the Contract Data.
Sub-Clause 1.1.92 Borrower	“ Borrower ” or “ Recipient ” means the person (if any) named as the borrower/recipient in the Contract Data.
Sub-Clause 1.1.93 ESHS	“ ESHS ” means Environmental, Social, Health and Safety.
Sub-Clause 1.1.94 Sexual Exploitation and Assault (SEA)	<p>“Sexual Exploitation and Assault” “(SEA)” stands for the following:</p> <p>Sexual exploitation is defined as any actual or attempted abuse of position of vulnerability, differential power or trust, for sexual purposes, including, but not limited to, profiting monetarily, socially or politically from the sexual exploitation of another. In Bank financed operations/projects, sexual exploitation occurs when access to or benefit from a Bank financed Goods, Works, Non-consulting Services or Consulting Services is used to extract sexual gain.</p> <p>Sexual assault is defined as sexual activity with another person who does not consent. It is a violation of bodily integrity and sexual autonomy and is broader than narrower conceptions of “rape”, especially because (a) it may be committed by other means than force or violence, and (b) it does not necessarily entail penetration.</p>
Sub-Clause 1.1.95 Milestone Certificate	“Milestone Certificate” means the certificate issued by the Engineer under Sub-Clause 4.26 [Milestone].
Sub-Clause 1.1.96 Milestone	“Milestone” means stage of completion of works in a given Cost Centre based on which payment will be made to the Contractor.
Sub-Clause 1.1.97 Key Date	“Key Date” means the time for completion for a part of the Plant and/or a part of the Works as described in detail in the Appendix 15, Section VII-1: General Specifications, Part 2 of the Employer’s Requirements.
Sub-Clause 1.1.98 Principal Employer	Principal Employer means ‘Haryana Orbital Rail Corporation Limited’.
Sub-Clause 1.2 Interpretation	Sub-paragraph (a) is replaced with the following:

	<p>(a) “Words indicating one gender include all genders; “he/she” is replaced with “it”;</p> <p>“him/her” is replaced with “it”;</p> <p>“his” and “his/her” are replaced with “its”;</p> <p>“himself/herself” are replaced with “itself”.”</p> <p>Further, “and” is deleted from the end of sub-paragraph (i) and added at the end of sub-paragraph (j).</p> <p>sub-paragraph (k) is added:</p> <p>(k) “The word “Tender” is synonymous with “Bid”, the word “Tenderer” with “Bidder” and the words “Tender Documents” with “Bidding documents” or “request for Bids documents”, as applicable.”</p>
<p>Sub-Clause 1.5 Priority of Documents</p>	<p>Replace subparagraphs from (a) to (k) with the following:</p> <p>(a) the Contract Agreement ,</p> <p>(b) the Letter of Acceptance,</p> <p>(c) the Addenda & Corrigenda issued before opening of the Tender,</p> <p>(d) the Letter of Tender-Financial Part,</p> <p>(e) the Letter of Tender-Technical Part,</p> <p>(f) the Particular Conditions -Part A (Contract Data),</p> <p>(g) the Particular Conditions -Part B (Specific Provisions),</p> <p>(h) the Particular Conditions Part C- Prohibited Practices</p> <p>(i) these General Conditions,</p> <p>(j) the Employers’ Requirements,</p> <p>(k) the Schedules,</p> <p>(l) any other documents forming part of the Contract.</p>

<p>Sub-Clause 1.12 Confidentiality</p>	<p>The following is added at the end of the second paragraph: “The Contractor shall be permitted to disclose information required to establish its qualifications to compete for other projects.”</p> <p>“or” at the end of (b) is deleted.</p> <p>“or” at the end of (c) is added.</p> <p>The following is then added as</p> <p>(d): “is being provided to the Bank .”</p>
<p>Sub-Clauses 1.17 and 1.18 are added after Sub-Clause 1.16</p>	
<p>Sub-Clause 1.17 Inspections & Audit by the Bank</p>	<p>“The Contractor shall permit and shall cause its agents (whether declared or not), subcontractors, subconsultants, service providers, suppliers, and their personnel, to permit the Bank and/or persons appointed by the Bank to inspect the site and/or the accounts, records and other documents relating to the procurement process, tender submission, proposal submission, and contract execution, and to have such accounts, records and other documents audited by auditors appointed by the Bank.”</p>
<p>Sub-Clause 1.18 Change in Control</p>	<p>The Contractor or its constituents shall inform the Employer about any change in “Control” during the execution of the Contract.</p>
<p>Sub-Clause 2.4 Employer’s Financial Arrangements</p>	<p>The first paragraph is replaced with:</p> <p>“The Employer shall submit, before the Commencement Date, reasonable evidence that financial arrangements have been made for financing the Employer’s obligations under the Contract.”</p> <p>The following sub-paragraph is added at the end of Sub-Clause 2.4:</p> <p>“In addition, if the Bank has notified to the Recipient that the Bank has suspended disbursements under its loan, which finances in whole or in part the execution of the Works, the Employer shall give notice of such suspension to the Contractor with detailed particulars, including the date of such notification, with a copy to the Engineer, within 7 days of the Recipient having received the suspension notification from the Bank. If alternative funds will be available in appropriate currencies to the Employer to continue making payments to the Contractor beyond a date 60 days after the date of Bank notification of the</p>

	suspension, the Employer shall provide reasonable evidence in its notice of the extent to which such funds will be available.”
Sub-Clause 3.1 The Engineer	The following is added at the end of the first sub-paragraph: “The Engineer’s staff shall include suitably qualified engineers and other professionals who are competent to carry out these duties.”
Sub-Clause 3.2 Engineer’s Duties and Authority	<p>The third paragraph of Sub-Clause 3.2 is replaced with:</p> <p>The Engineer may exercise the authority attributable to the Engineer as specified in or necessarily to be implied from the Contract. However, the Engineer shall obtain the consent in writing of the Employer before taking action under the following Sub-Clauses of these Conditions:</p> <p>(a) Sub-Clause 4.12 [Unforeseeable Physical Conditions]: agreeing or determining an extension of time and/or additional cost.</p> <p>(b) Sub-Clause 8.5 [Extension of Time for Completion]: agreeing or determining extension of time.</p> <p>(c) Sub-Clause 11.9 [Performance Certificate]: issue of Performance Certificate.</p> <p>(d) Clause 20.1: [Claims]: agreeing or determining extension of time and/or additional payment.</p> <p>Notwithstanding anything to the contrary contained in this Sub-Clause 3.2, as set out above, if in the opinion of the Engineer, an emergency occurs which adversely affects safety of, (a) life, (b) Works, or (c) any adjoining property, the Engineer may, without obtaining prior approval of the Employer and without relieving the Contractor of any of its duties and responsibilities under the Contract, instruct the Contractor to execute all such work or to do all such things as may, in the opinion of the Engineer, be necessary to abate or reduce the aforesaid risk(s). The Contractor shall forthwith comply with such directions of the Engineer despite the absence of Employer’s specific approval in this regard. The Engineer shall determine an addition to the Contract Price, in respect of such instruction(s), in accordance with Clause 13 [Variations and Adjustments],</p>

	<p>and shall notify the Contractor accordingly, with a copy to the Employer.</p> <p>However, in case the concerned emergency as specified in the above para occurs on account of any failure by the Contractor to comply with the terms and conditions of the Contract, including but not limited to, (a) not adhering to the approved scheme of work (b) not taking adequate safety precautions, or (c) by any other reason attributable to the Contractor, no additional amounts shall be paid to the Contractor for attending to such emergencies and the Contractor shall be liable for Employer's claims in this regard".</p>
Sub-Clause 3.3 Engineer's Representative	<p>The following is added at the end of Sub-Clause 3.3: "The Engineer shall obtain the consent of the Employer before appointing or replacing an Engineer's Representative."</p>
Sub-Clause 3.4 Delegation by the Engineer	<p>The following is added at the end of the second paragraph: "If any assistants are not fluent in this language, the Engineer shall make competent interpreters available during all working hours, in a number sufficient for those assistants to properly perform their assigned duties and/or exercise their delegated authority."</p>
Sub-Clause 3.6 Replacement of the Engineer	<p>In the first paragraph, "42 days" is replaced with "21 days";</p> <p>In the third para, "shall" is replaced with "should".</p>
Sub-Clause 4.1 Contractor's General Obligations	<p>The following is inserted after the second paragraph "The Contractor shall provide the Plant (and spare parts, if any)...": "All equipment, material, and services to be incorporated in or required for the Works shall have their origin in any eligible source country as defined by the Bank."</p> <p>The following is inserted after the fifth paragraph "The Contractor shall, whenever required by the Engineer...":</p> <p>The Contractor shall not carry out mobilization to Site (e.g. limited clearance for haul roads, site accesses and work site establishment, geotechnical investigations or investigations to select ancillary features such as quarries and borrow pits) unless the Engineer gives consent, a consent that shall not be</p>

	<p>unreasonably delayed, that appropriate measures are in place to address environmental and social risks and impacts, which at a minimum shall include applying the Management Strategies and Implementation Plans (MSIPs) and Code of Conduct for Contractor’s Personnel as part of the Contract.</p> <p>The Contractor shall submit, to the Engineer for Review any additional MSIPs as are necessary to manage the ESHS risks and impacts of ongoing Works (e.g. excavation, earth works, bridge and structure works, stream and road diversions, quarrying or extraction of materials, concrete batching and asphalt manufacture). These MSIPs shall be included in the Contractor’s Environmental and Social Management Plan (C-ESMP). The Contractor shall review the C-ESMP, periodically (but not less than every six (6) months), and update it as required to ensure that it contains measures appropriate to the Works. The updated C-ESMP shall be submitted to the Engineer for Review.</p> <p>The C-ESMP shall be part of the Contractor’s Documents. The procedures for Review of the C-ESMP and its updates shall be as described in Sub-Clause 5.2 .1 [<i>Preparation by Contractor</i>] and Sub-Clause 5.2.2 [<i>Review by Engineer</i>].</p> <p>If so stated in the Employer’s Requirements, the Contractor shall:</p> <ul style="list-style-type: none"> (i) design structural elements of the Works taking into account climate change considerations; and (ii) apply the concept of universal access (the concept of universal access means unimpeded access for people of all ages and abilities in different situations and under various circumstances. <p>“The Contractor shall provide relevant contract- related information, as the Employer and/or Engineer may reasonably request to conduct Stakeholder engagements. “Stakeholder” refers to individuals or groups who:</p> <ul style="list-style-type: none"> (i) are affected or likely to be affected by the Contract; and (ii) may have an interest in the Contract.
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	<p>The Contractor may also directly participate in Stakeholder engagements, as the Employer and/or Engineer may reasonably request.”</p> <p>“The Contractor shall require that it’s subcontractors execute the Works in accordance with the Contract, including complying with the relevant ESHS requirements.”</p>
<p>Sub-Clause 4.2 Performance Security</p>	<p>Replace Sub-Clause 4.2.1 with the following:</p> <p>The Contractor shall, within 28 days of the date of receiving the Letter of Acceptance, provide to the Employer, the Performance Security in a sum equal to the amount specified in the Contract Data, for the due observance and performance by the Contractor of the Contract. In the event the Contractor fails to provide the Performance Security within 28 days from the date of issue of the LOA, it may seek an extension of time for providing the performance security for a period not exceeding a further 14 days on payment of damages for such extended period in a sum calculated at the rate of 0.005% of the Accepted Contract Amount for each day until the Performance Security is provided. The Contractor shall maintain the said Performance Security at its own expense, so that it shall remain in full force and effect until the issue of Performance Certificate. In the event of a revision of the Contract Price, the value of the Performance Security shall be increased proportionately by the Contractor, if required by the Employer. The cost of obtaining the Performance Security shall be at the expense of the Contractor. The Contractor shall submit the Performance Security in any of the following forms:</p> <p>(a) Unconditional and irrevocable Bank Guarantee from the specified banks in the form appearing in Section X [Contract Forms] as under:</p> <p style="padding-left: 40px;">(i) a scheduled bank (excluding co-operative banks) in India, or</p> <p style="padding-left: 40px;">(ii) a Foreign Bank having arrangement with a nationalized bank or scheduled banks (excluding co-operative banks) in India;</p>

	<p>(b) Banker's Cheque or Demand Draft drawn on a scheduled bank (excluding co-operative banks) or nationalized bank in India.</p> <p>The scheduled bank issuing the bank guarantee shall be on “Structure Financial Messaging System (SFMS)” platform. A separate advice of the bank guarantee shall invariably be sent by the issuing bank to Employer’s Bank through SFMS and only of the same by the Employer’s Bank, the bank guarantee shall become operative and acceptable to the Employer. Further, the bank guarantees in original form along with a copy of “MT760COV (in case of bank guarantee message)/ MT767COV (in case of bank guarantee amendment message) Report” sent by the concerned issuing bank sealed in an envelope shall be submitted to the Employer.</p> <p>The Issuing Bank shall send the SFMS to:</p> <p>Beneficiary: Haryana Orbital Rail Corporation Limited</p> <p>Bank Name:</p> <p>IFSC Code:</p> <p>Note: All the instruments mentioned in (a) & (b) above should be in favour of Haryana Orbital Rail Corporation Limited, Plot No 143, 5th Floor, Railtel Tower, Sector-44, Gurugram.</p> <p>The Contractor shall ensure that the Performance Security is valid and enforceable until the Contractor has executed and completed the Works and remedied defects, if any. If, (a) the Contractor does not complete the Works for any reasons whatsoever, and (b) the Contractor has not become entitled to receive the Performance Certificate by 28 days prior to the expiry date of the Performance Security, the Contractor shall be bound to extend the validity of the Performance Security until the Works have been completed and the defects have been remedied. If the Performance Security is or becomes invalid or unenforceable for any reason whatsoever, or if such security is withdrawn or expires, the Contractor must immediately notify the Employer and obtain within 3 days a</p>
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	<p>replacement guarantee in the form appearing in Section X [Contract Forms] and which is acceptable to the Employer in its absolute discretion.</p> <p>The provision, maintenance and renewal by the Contractor of the Performance Security in accordance with this Sub-Clause 4.2 [Performance Security] shall be a condition precedent to any payment by the Employer to the Contractor under the Contract.</p> <p>If the Contractor fails to provide, maintain and renew the Performance Security in accordance with the Contract, the Employer shall, without prejudice to any other rights and remedies to which it may be entitled, shall have the right to invoke the Performance Security for the value equal to the damages to the Employer as a result of the Contractor's failure and/or by written notice terminate the Contract in accordance with Clause 15.</p>
<p>Sub-Clause 4.3 Contractor's Representative</p>	<p>The following is added at the end of the last paragraph: "If any of these persons is not fluent in this language, the Contractor shall make competent interpreters available during all working hours in a number deemed sufficient by the Engineer."</p>
<p>Sub-Clause 4.8 Health and Safety Obligations</p>	<p>The following are included after deleting "and" at the end of (f) and replacing "." with ";" at the end of (g):</p> <p>“</p> <ul style="list-style-type: none"> (i) provide health and safety training of Contractor's Personnel as appropriate and maintain training records; (ii) actively engage the Contractor's Personnel in promoting understanding, and methods for, implementation of health and safety requirements, as well as in providing information to Contractor's Personnel, training on occupational safety and health, and provision of personal protective equipment without expense to the Contractor's Personnel; (iii) put in place workplace processes for Contractor's Personnel to report work situations that they believe are not safe or healthy, and to remove themselves from a work situation which they have reasonable justification to believe presents an imminent and serious danger to their life or health. (iv) Contractor's Personnel who remove themselves from such work situations shall not be required to return to work until necessary remedial action to correct the

	<p>situation has been taken. Contractor's Personnel shall not be retaliated against or otherwise subject to reprisal or negative action for such reporting or removal;</p> <p>(v) subject to Sub-Clause 4.6, where the Employer's Personnel, any other contractors employed by the Employer, and/or personnel of any legally constituted public authorities and private utility companies are employed in carrying out, on or near the site, of any work not included in the Contract, collaborate in applying the health and safety requirements, without prejudice to the responsibility of the relevant entities for the health and safety of their own personnel; and</p> <p>(vi) establish and implement a system for regular (not less than six-monthly) review of health and safety performance and the working environment.”</p> <p>The second and third paragraphs are replaced with the following:</p> <p>“Within 21 days of the Commencement Date and before commencing any construction on the Site, the Contractor shall submit to the Engineer for Review a health and safety manual which has been specifically prepared for the Works, the Site and other places (if any) where the Contractor intends to execute the Works. The procedures for Review of the health and safety manual and its updates shall be as described in Sub-Clause 5.2.1 [<i>Preparation by Contractor</i>] and Sub-Clause 5.2.2 [<i>Review by Engineer</i>].</p> <p>The health and safety manual shall be in addition to any other similar document required under applicable health and safety regulations and Laws.</p> <p>The health and safety manual shall set out all the health and safety requirements under the Contract,</p> <p>a) which shall include at a minimum:</p> <p>(i) the procedures to establish and maintain a safe working environment without risk to health at all workplaces, machinery, equipment and processes under the control of the Contractor, including control measures for chemical, physical and biological substances and agents;</p> <p>(ii) details of the training to be provided, records to be kept;</p> <p>(iii) the procedures for prevention, preparedness and response activities to be implemented in</p>
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	<p>the case of an emergency event (i.e. an unanticipated incident, arising from both natural and man-made hazards, typically in the form of fire, explosions, leaks or spills, which may occur for a variety of different reasons including failure to implement operating procedures that are designed to prevent their occurrence, extreme weather or lack of early warning);</p> <p>(iv) remedies for adverse impacts such as occupational injuries, deaths, disability and disease;</p> <p>(v) the measures to be taken to avoid or minimize the potential for community exposure to water-borne, water-based, water-related, and vector-borne diseases,</p> <p>(vi) the measures to be implemented to avoid or minimize the spread of communicable diseases (including transfer of Sexually Transmitted Diseases or Infections (STDs), such as HIV virus) and non-communicable diseases associated with the execution of the Works, taking into consideration differentiated exposure to and higher sensitivity of vulnerable groups. This includes taking measures to avoid or minimize the transmission of communicable diseases that may be associated with the influx of temporary or permanent Contract-related labour;</p> <p>(vii) the policies and procedures on the management and quality of accommodation and welfare facilities if such accommodation and welfare facilities are provided by the Contractor in accordance with Sub-Clause 6.6; and</p> <p>b) any other requirements stated in the Specification.</p> <p>The paragraph starting with: “In addition to the reporting requirement of...” is replaced with the following:</p> <p>“In addition to the reporting requirement of sub-paragraph (g) of Sub-Clause 4.20 [<i>Progress Reports</i>] the Contractor shall inform the Engineer immediately of any allegation, incident or accident in the Site, which has or is likely to have a significant adverse effect on the environment, the affected communities,</p>
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	<p>the public, Employer’s Personnel or Contractor’s Personnel. This includes, but is not limited to, any incident or accident causing fatality or serious injury; significant adverse effects or damage to private property; or any allegation of SEA. In case of SEA, while maintaining confidentiality as appropriate, the type of allegation (sexual exploitation, or sexual assault), gender and age of the person who experienced the alleged incident should be included in the information.</p> <p>The Contractor, upon becoming aware of the allegation, incident or accident, shall also immediately inform the Engineer of any such incident or accident on the Subcontractors’ or suppliers’ premises relating to the Works which has or is likely to have a significant adverse effect on the environment, the affected communities, the public, Employer’s Personnel or Contractor’s, its Subcontractors’ and suppliers’ personnel. The notification shall provide sufficient detail regarding such incidents or accidents. The Contractor shall provide full details of such incidents or accidents to the Engineer within the timeframe agreed with the Engineer.</p> <p>The Contractor shall require its Subcontractors and suppliers (other than Subcontractors) to immediately notify the Contractor of any incidents or accidents referred to in this Sub-clause.”</p>
<p>Sub-Clause 4.10 Use of Site Data</p>	<p>Add at the end of paragraph 1 of Sub-Clause 4.10.</p> <p>“Accordingly, the Contractor shall have no claim in this regard.”</p> <p>In paragraph 2 of Sub-Clause 4.10.</p> <p>Delete the words “To the extent which was practicable (taking account of cost and time)”. Start the word “the” with a capital letter.</p> <p>Delete “To the same extent” from the fourth line and Start the word “the” with a capital letter.</p> <p>Add following (f) after existing Sub-Clause 4.10 (e) as under:</p> <p>“(f) damage to property adjacent to the Site and the risk of injury to the occupiers of such property due to execution of the Works.”</p>

<p>Sub-Clause 4.15 Access Route</p>	<p>The following is added at the end of Sub-Clause 4.15:</p> <p>“The Contractor shall take all necessary safety measures to avoid the occurrence of incidents and injuries to any third party associated with the use of Contractor’s Equipment on public roads or other public infrastructure.</p> <p>The Contractor shall monitor road safety incidents and accidents to identify negative safety issues and establish and implement necessary measures to resolve them.</p>
<p>Sub-Clause 4.18 Protection of the Environment</p>	<p>Sub-Clause 4.18 Protection of the Environment is replaced with:</p> <p>“The Contractor shall take all necessary measures to:</p> <ul style="list-style-type: none"> (a) protect the environment (both on and off the Site); and (b) limit damage and nuisance to people and property resulting from pollution, noise and other results of the Contractor’s operations and/ or activities. <p>The Contractor shall ensure that emissions, surface discharges, effluent and any other pollutants from the Contractor’s activities shall exceed neither the values indicated in the Employer’s Requirements, nor those prescribed by applicable Laws.</p> <p>In the event of damage to the environment, property and/or nuisance to people, on or off Site as a result of the Contractor’s operations, the Contractor shall agree with the Engineer the appropriate actions and time scale to remedy, as practicable, the damaged environment to its former condition. The Contractor shall implement such remedies at its cost to the satisfaction of the Engineer.</p> <p>The Contractor shall comply with the Environmental and Social Management Plan, the Code of Conduct, and the Guidelines on Gender Based Violence as given in Section VII-4:ESHS Manual, Part 2, Employer’s Requirements.”</p>
<p>Sub-Clause 4.20 Progress Reports</p>	<p>Replace “4.20 (g) with: “the Environmental, Social, Health and Safety (ESHS) metrics set out in Section VII-4: ESHS Manual, Part 2, Employer’s Requirements.</p>

<p>Sub-Clause 4.21 Security of the Site</p>	<p>Sub-Clause 4.21 Security of the Site is replaced with:</p> <p>“The Contractor shall be responsible for the security of the Site, and:</p> <p>(a) for keeping unauthorized persons off the Site;</p> <p>(b) authorized persons shall be limited to the Contractor’s Personnel, the Employer’s Personnel, and to any other personnel identified as authorized personnel (including the Employer’s other contractors on the Site), by a Notice from the Employer or the Engineer to the Contractor.</p> <p>The Contractor shall, within 21 days of the Commencement Date, submit for the Engineer’s No-objection a security management plan that sets out the security arrangements for the Site.</p> <p>The Contractor shall (i) conduct appropriate background checks on any personnel retained to provide security; (ii) train the security personnel adequately (or determine that they are properly trained) in the use of force (and where applicable, firearms), and appropriate conduct towards Contractor’s Personnel, Employer’s Personnel and affected communities; and (iii) require the security personnel to act within the applicable Laws and any requirements set out in the Employer’s Requirements.</p> <p>The Contractor shall not permit any use of force by security personnel in providing security except when used for preventive and defensive purposes in proportion to the nature and extent of the threat.</p> <p>In making security arrangements, the Contractor shall also comply with any additional requirements stated in the Employer’s Requirements.”</p>
<p>Sub-Clause 4.22 Contractor’s Operations on Site</p>	<p>On the third line of the second paragraph before “4.17”, “Sub-Clause” is added.</p>
<p>Sub-Clause 4.23 Archaeological and Geological Findings</p>	<p>The first paragraph is replaced with the following:</p>

	<p>“All fossils, coins, articles of value or antiquity, structures, groups of structures, and other remains or items of geological, archaeological, paleontological, historical, architectural or religious interest found on the Site shall be placed under the care and custody of the Employer. The Contractor shall:</p> <ul style="list-style-type: none"> (a) take all reasonable precautions, including fencing-off the area or site of the finding, to avoid further disturbance and prevent Contractor’s Personnel or other persons from removing or damaging any of these findings; (b) train relevant Contractor’s Personnel on appropriate actions to be taken in the event of such findings; and (c) implement any other action consistent with the requirements of the Employer’s Requirements and relevant Laws.”
<p>Sub-Clause 4.24 to 4.26 are added after Sub-Clause 4.23</p>	
<p>Sub-Clause 4.24 Suppliers (other than Subcontractors)</p>	<p>4.24.1 Forced Labour</p> <p>The Contractor shall take measures to require its suppliers (other than Subcontractors) not to employ or engage forced labour including trafficked persons as described in Sub-Clause 6.21. If forced labour/trafficking cases are identified, the Contractor shall take measures to require the suppliers to take appropriate steps to remedy them. Where the supplier does not remedy the situation, the Contractor shall within a reasonable period substitute the supplier with a supplier that is able to manage such risks.</p> <p>4.24.2 Child labour</p> <p>The Contractor shall take measures to require its suppliers (other than Subcontractors) not to employ or engage child labour as described in Sub-Clause 6.22. If child labour cases are identified, the Contractor shall take measures to require the suppliers to take appropriate steps to remedy them. Where the supplier does not remedy the situation, the Contractor shall within a reasonable period substitute the supplier with a supplier that is able to manage such risks.</p> <p>4.24.3 Serious Safety Issues</p> <p>The Contractor, including its Subcontractors (if any), shall comply with all applicable safety obligations, including as stated in Sub-Clauses 4.8, 5.1 and 6.7. The Contractor shall also take measures to require its suppliers (other than Subcontractors) to introduce procedures and mitigation measures to address safety issues related to their personnel. If</p>

	<p>serious safety issues are identified, the Contractor shall take measures to require the suppliers to take appropriate steps to remedy them. Where the supplier does not remedy the situation, the Contractor shall within a reasonable period substitute the supplier with a supplier that is able to manage such risks.</p> <p>4.24.4 Obtaining natural resource materials in relation to supplier</p> <p>The Contractor shall obtain natural resource materials from suppliers that can demonstrate, through compliance with the applicable verification and/ or certification requirements, that obtaining such materials is not contributing to the risk of significant conversion or significant degradation of natural or critical habitats such as unsustainably harvested wood products, gravel or sand extraction from river beds or beaches.</p> <p>If a supplier cannot continue to demonstrate that obtaining such materials is not contributing to the risk of significant conversion or significant degradation of natural or critical habitats, the Contractor shall within a reasonable period substitute the supplier with a supplier that is able to demonstrate that they are not significantly adversely impacting the habitats.</p>
<p>Sub-Clause 4.25 Code of Conduct</p>	<p>The Contractor shall have a Code of Conduct for the Contractor's Personnel.</p> <p>The Contractor shall ensure that each Contractor's Personnel is provided a copy of this Code of Conduct, written in a language comprehensible to that person, and shall seek to obtain that person's signature acknowledging receipt of the same.</p> <p>The Contractor shall also ensure that the Code of Conduct is visibly displayed in multiple locations on the Site and any other place where the Works will be carried out, as well as in areas outside the Site accessible to the local community and project affected people. The posted Code of Conduct shall be provided in languages comprehensible to Contractor's Personnel, Employer's Personnel and the local community.</p>

<p>Sub-Clause 4.26</p> <p>Milestone</p>	<p>Sub-Clause 4.26 Milestone</p> <p>If no Milestones are specified in the Contract, this Sub-Clause shall not apply.</p> <p>The Contractor shall complete the works of each Milestone (including all work which is stated in the Employer's Requirements as being required for the Milestone to be considered complete).</p> <p>The Contractor shall apply, by notice to the Engineer, for a Milestone Certificate not earlier than 14 days before the works of a Milestone will, in the Contractor's opinion, be complete. The Engineer shall within 28 days after receiving the Contractor's notice:</p> <ul style="list-style-type: none"> (a) issue the Milestone Certificate to the Contractor, stating the date on which the works of the Milestone were completed in accordance with the Contract, except for any minor outstanding work and defects (as shall be listed in the Milestone Certificate); or (b) reject the application, giving reasons and specifying the work required to be done and defects required to be remedied by the Contractor to enable the Milestone Certificate to be issued. <p>The Contractor shall then complete the work referred to in subparagraph (b) of this Sub-Clause before issuing a further notice of application under this Sub-Clause.</p>
<p>Sub-Clause 5.1</p> <p>General Design Obligations</p>	<p>Add the following at the end of Sub-Clause 5.1</p> <p>The Contractor shall furnish Contractor's Warranty in the in the form included in Section X [Contract Forms].</p> <p>"All subcontracts relating to the Works shall include provisions which entitle the Employer to require the subcontract to be assigned to the Employer under subparagraph (a) of Sub-Clause 15.2.3 [After Termination]</p>
<p>Sub-Clause 6.1</p> <p>Engagement of Staff and Labour</p>	<p>The following paragraphs are added at the end of the Sub-Clause:</p> <p>The Contractor shall provide the Contractor's Personnel information and documentation that are clear and understandable regarding their terms and conditions of employment. The information and documentation shall set out</p>

	<p>their rights under relevant labour Laws applicable to the Contractor's Personnel (which will include any applicable collective agreements), including their rights related to hours of work, wages, overtime, compensation and benefits, as well as those arising from any requirements in the Employer's Requirements; and shall also include the Code of Conduct for Contractor's Personnel as set forth in Sub-Clause 4.25. The Contractor's Personnel shall be informed when any material changes to their terms or conditions of employment occur.</p> <p>"The Contractor is encouraged, to the extent practicable and reasonable, to employ staff and labour with appropriate qualifications and experience from sources within the Country."</p>
<p>Sub-Clause 6.2 Rates of Wages and Conditions of Labour</p>	<p>The following paragraphs are added at the end of the Sub-Clause:</p> <p>"The Contractor shall inform the Contractor's Personnel about:</p> <ul style="list-style-type: none"> (a) any deduction to their payment and the conditions of such deductions in accordance with the applicable Laws or as stated in the Employer's Requirements; and (b) their liability to pay personal income taxes in the Country in respect of such of their salaries, wages, allowances and any benefits as are subject to tax under the Laws of the Country for the time being in force. <p>The Contractor shall perform such duties in regard to such deductions thereof as may be imposed on him by such Laws. Where required by applicable Laws or as stated in the Employer's Requirements, the Contractor shall provide the Contractor's Personnel written notice of termination of employment and details of severance payments in a timely manner. The Contractor shall have paid the Contractor's Personnel (either directly or where appropriate for their benefit) all due wages and entitlements including, as applicable, social security benefits and pension contributions, on or before the end of their engagement/ employment.</p> <p>If any amenity required to be provided under any Section of Contract Labour (Regulation and Abolition) Act of 1970 for the benefit of the contract labour employed in an establishment, is not provided by the Contractor within the time prescribed therein, such amenity shall be provided by the Principal Employer within such time as may be prescribed. All expenses incurred by the Principal Employer in providing the</p>

	<p>amenities will be recovered from the amount payable under the Contract.</p> <p>In case the Contractor fails to make payment of wages within the prescribed period or makes short payment, then the Principal Employer will make payment of wages in full or the unpaid balance due, as the case may be, to the contract labour employed by the Contractor and recover the amount so paid from the amount payable under the Contract.</p> <p>The Contractor shall keep the Employer indemnified in case any action is taken against the Employer by the competent authority on account of contravention of any of the provisions of applicable Laws. If the Employer is caused to pay or reimburse, such amounts as may be necessary to cause or observe, or for non-observance of the provisions stipulated in the notifications/bye laws/Acts/Rules/Regulations including amendments, if any, on the part of the Contractor, the Employer shall have the right to deduct any money due to the Contractor including his amount of Performance Security. The Employer shall also have right to recover from the Contractor any sum required or estimated to be required for making good the loss or damage suffered by the Employer.</p> <p>For the avoidance of any doubt, the Contractor shall be responsible for payment of applicable cess and making timely filings under the Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996.”</p>
<p>Sub-Clause 6.5 Working Hours</p>	<p>The following paras are inserted at the end of the Sub-Clause:</p> <p>The Contractor shall provide the Contractor’s Personnel annual holiday and sick, maternity and family leave, as required by applicable Laws or as stated in the Employer’s Requirements.”</p> <p>The Contractor, if required, shall take approval of Engineer for carrying out work during night hours or in shifts subject to compliance with applicable Laws and shall be responsible for all necessary safety arrangements with respect to the work being undertaken. However, the Contractor shall not be entitled to any claim for increase in rates or any additional cost and the same shall be deemed to be included in the Contract Price.</p>
<p>Sub-Clause 6.7 Health and Safety of Personnel</p>	<p>In the second paragraph, “The Contractor” is replaced with:</p>

	<p>“Except as otherwise stated in the Employer’s Requirements, the Contractor...”</p>
<p>Sub-Clause 6.9 Contractor’s Personnel</p>	<p>The Sub-Clause is replaced with:</p> <p>“The Contractor’s Personnel (including Key Personnel, if any) shall be appropriately qualified, skilled, experienced and competent in their respective trades or occupations.</p> <p>The Engineer may require the Contractor to remove (or cause to be removed) any person employed on the Site or Works, including the Contractor’s Representative and Key Personnel (if any), who:</p> <ul style="list-style-type: none"> (a) persists in any misconduct or lack of care; (b) carries out duties incompetently or negligently; (c) fails to comply with any provision of the Contract; (d) persists in any conduct which is prejudicial to safety, health, or the protection of the environment; (e) based on reasonable evidence, is determined to have engaged in Prohibited Practice during the execution of the Works; (f) has been recruited from the Employer’s Personnel in breach of Sub-Clause 6.3 [Recruitment of Persons]; (g) undertakes behaviour which breaches the Code of Conduct for Contractor’s Personnel (ESHS). <p>If appropriate, the Contractor shall then promptly appoint (or cause to be appointed) a suitable replacement with equivalent skills and experience. In the case of replacement of the Contractor’s Representative, Sub-Clause 4.3 [<i>Contractor’s Representative</i>] shall apply. In the case of replacement of Key Personnel (if any), Sub-Clause 6.12 [<i>Key Personnel</i>] shall apply</p> <p>Subject to the requirements in Sub-Clause 4.3 [<i>Contractor’s Representative</i>] and 6.12 [<i>Key Personnel</i>], and notwithstanding any requirement from the Engineer to remove or cause to remove any person, the Contractor shall take immediate action as appropriate in response to any violation of (a) through (g) above. Such immediate action shall include removing (or causing to be removed) from the Site or other places where the Works are being carried out, any Contractor’s Personnel who engages in (a), (b), (c), (d), (e) or (g) above or has been recruited as stated in (f) above.”</p>
<p>Sub-Clause 6.12 Key Personnel</p>	<p>The following is inserted at the end of the last paragraph:</p>

	<p>“If any of the Key Personnel are not fluent in this language, the Contractor shall make competent interpreters available during all working hours in a number deemed sufficient by the Engineer.”</p>
<p>The following Sub-Clauses 6.13 to 6.27 are added after sub-clause 6.12</p>	
<p>Sub-Clause 6.13 Foreign Personnel</p>	<p>The Contractor may bring into the Country any foreign personnel who are necessary for the execution of the Works to the extent allowed by the applicable Laws. The Contractor shall ensure that these personnel are provided with the required residence visas and work permits. The Employer will, if requested by the Contractor, use its best endeavors in a timely and expeditious manner to assist the Contractor in obtaining any local, state, national, or government permission required for bringing in the Contractor’s personnel.</p> <p>The Contractor shall be responsible for the return of these personnel to the place where they were recruited or to their domicile. In the event of the death in the Country of any of these personnel or members of their families, the Contractor shall similarly be responsible for making the appropriate arrangements for their return or burial.</p>
<p>Sub-Clause 6.14 Supply of Foodstuffs</p>	<p>The Contractor shall arrange for the provision of a sufficient supply of suitable food as may be stated in the Employer’s Requirements at reasonable prices for the Contractor’s Personnel for the purposes of or in connection with the Contract.</p>
<p>Sub-Clause 6.15 Supply of Water</p>	<p>The Contractor shall, having regard to local conditions, provide on the Site an adequate supply of drinking and other water for the use of the Contractor’s Personnel.</p>
<p>Sub-Clause 6.16 Measures against Insect and Pest Nuisance</p>	<p>The Contractor shall at all times take the necessary precautions to protect the Contractor’s Personnel employed on the Site from insect and pest nuisance, and to reduce the danger to their health. The Contractor shall comply with all the regulations of the local health authorities, including use of appropriate insecticide.</p>
<p>Sub-Clause 6.17 Alcoholic Liquor or Drugs</p>	<p>The Contractor shall not, otherwise than in accordance with the Laws of the Country, import, sell, give, barter or otherwise dispose of any alcoholic liquor or drugs, or permit or allow importation, sale, gift, barter or disposal thereto by Contractor’s Personnel.</p>

Sub-Clause 6.18 Arms and Ammunition	The Contractor shall not give, barter, or otherwise dispose of, to any person, any arms or ammunition of any kind, or allow Contractor's Personnel to do so.
Sub-Clause 6.19 Festivals and Religious Customs	The Contractor shall respect the Country's recognized festivals, days of rest and religious or other customs.
Sub-Clause 6.20 Funeral Arrangements	The Contractor shall be responsible, to the extent required by local regulations, for making any funeral arrangements for any of its local employees who may die while engaged upon the Works.
Sub-Clause 6.21 Forced Labour	<p>The Contractor, including its Subcontractors, shall not employ or engage forced labour. Forced labour consists of any work or service, not voluntarily performed, that is exacted from an individual under threat of force or penalty, and includes any kind of involuntary or compulsory labour, such as indentured labour, bonded labour or similar labour-contracting arrangements.</p> <p>No persons shall be employed or engaged who have been subject to trafficking. Trafficking in persons is defined as the recruitment, transportation, transfer, harbouring or receipt of persons by means of the threat or use of force or other forms of coercion, abduction, fraud, deception, abuse of power, or of a position of vulnerability, or of the giving or receiving of payments or benefits to achieve the consent of a person having control over another person, for the purposes of exploitation.</p>
Sub-Clause 6.22 Child Labour	<p>The Contractor, including its Subcontractors, shall not employ or engage a child (as defined in Child Labour (Prohibition & Regulation) Act, 1986).</p> <p>The Contractor, including its Subcontractors, shall not employ or engage a child between the minimum age and the age of 18 in a manner that is likely to be hazardous, or to interfere with, the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development.</p> <p>The Contractor including its Subcontractors, shall only employ or engage children between the minimum age and the age of 18 after an appropriate risk assessment has been conducted by the Contractor with the Engineer's consent. The Contractor shall be subject to regular monitoring by the Engineer that includes monitoring of health, working conditions and hours of work.</p> <p>Work considered hazardous for children is work that, by its nature or the circumstances in which it is carried out, is likely</p>

	<p>to jeopardize the health, safety, or morals of children. Such work activities prohibited for children include work:</p> <ul style="list-style-type: none"> (a) with exposure to physical, psychological or sexual abuse; (b) underground, underwater, working at heights or in confined spaces; (c) with dangerous machinery, equipment or tools, or involving handling or transport of heavy loads; (d) in unhealthy environments exposing children to hazardous substances, agents, or processes, or to temperatures, noise or vibration damaging to health; or under difficult conditions such as work for long hours, during the night or in confinement on the premises of the employer.
<p>Sub-Clause 6.23 Employment Records of Workers</p>	<p>The Contractor shall keep complete and accurate records of the employment of labour at the Site. The records shall include the names, ages, genders, hours worked, and wages paid to all workers. These records shall be summarised on a monthly basis and submitted to the Engineer. These records shall be included in the details to be submitted by the Contractor under Sub-Clause 6.10 [Records of Contractor's Personnel and Equipment].</p>
<p>Sub-Clause 6.24 Workers' Organisations</p>	<p>In countries where the relevant labour laws recognise workers' rights to form and to join workers' organisations of their choosing and to bargain collectively without interference, the Contractor shall comply with such laws. In such circumstances, the role of legally established workers' organizations and legitimate workers' representatives will be respected, and they will be provided with information needed for meaningful negotiation in a timely manner. Where the relevant labour laws substantially restrict workers' organisations, the Contractor shall enable alternative means for the Contractor's Personnel to express their grievances and protect their rights regarding working conditions and terms of employment. The Contractor shall not seek to influence or control these alternative means. The Contractor shall not discriminate or retaliate against the Contractor's Personnel who participate, or seek to participate, in such organisations and collective bargaining or alternative mechanisms. Workers' organisations are expected to fairly represent the workers in the workforce.</p>
<p>Sub-Clause 6.25 Non-Discrimination and Equal Opportunity</p>	<p>The Contractor shall not make decisions relating to the employment or treatment of Contractor's Personnel on the basis of personal characteristics unrelated to inherent job</p>

	<p>requirements. The Contractor shall base the employment of Contractor's Personnel on the principle of equal opportunity and fair treatment, and shall not discriminate with respect to any aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, job assignment, promotion, termination of employment or retirement, and disciplinary practices.</p> <p>Special measures of protection or assistance to remedy past discrimination or selection for a particular job based on the inherent requirements of the job shall not be deemed discrimination. The Contractor shall provide protection and assistance as necessary to ensure non-discrimination and equal opportunity, including for specific groups such as women, people with disabilities, migrant workers and children (of working age in accordance with Sub-Clause 6.22).</p> <p>The Contractor shall give preference to local people including Project Affected Persons (PAPs) for employment opportunity during construction and enhance female work force participation.</p>
<p>Sub-Clause 6.26 Contractor's Personnel Grievance Mechanism</p>	<p>The Contractor shall have a grievance mechanism for Contractor's Personnel, and where relevant the workers' organizations stated in Sub-Clause 6.24, to raise workplace concerns. The grievance mechanism shall be proportionate to the nature, scale, risks and impacts of the Contract. The mechanism shall address concerns promptly, using an understandable and transparent process that provides timely feedback to those concerned in a language they understand, without any retribution, and shall operate in an independent and objective manner.</p> <p>The Contractor's Personnel shall be informed of the grievance mechanism at the time of engagement for the Contract, and the measures put in place to protect them against any reprisal for its use. Measures will be put in place to make the grievance mechanism easily accessible to all Contractor's Personnel.</p> <p>The grievance mechanism shall not impede access to other judicial or administrative remedies that might be available, or substitute for grievance mechanisms provided through collective agreements.</p> <p>The grievance mechanism may utilize existing grievance mechanisms, providing that they are properly designed and implemented, address concerns promptly, and are readily accessible to such project workers. Existing grievance</p>

	mechanisms may be supplemented as needed with Contract-specific arrangements.
Sub-Clause 6.27 Training of Contractor's Personnel	<p>The Contractor shall provide appropriate training to relevant Contractor's Personnel on ESHS aspects of the Contract, including appropriate sensitization on prohibition of SEA, Gender Based Violence (GBV) and health & safety training referred to in Sub-Clause 4.8.</p> <p>As stated in the Employer's Requirements or as instructed by the Engineer, the Contractor shall also allow appropriate opportunities for the relevant Contractor's Personnel to be trained on ESHS aspects of the Contract by the Employer's Personnel.</p> <p>The Contractor shall provide training on SEA, GBV including its prevention, to any of its personnel who has a role to supervise other Contractor's Personnel.</p>
Sub-Clause 7.3 Inspection	<p>The following is added in the first paragraph after "Employer's Personnel" "(including the Bank staff or consultants acting on the Bank's behalf, stakeholders and third parties, such as independent experts, local communities, or non-governmental organizations)"</p> <p>The following is added as (b) (iv):</p> <p>"(iv) carryout environmental and social audit, and"</p>
Sub-Clause 7.7 Ownership of Plant and Materials	<p>The following is added before the first paragraph:</p> <p>"Except as otherwise provided in the Contract,"</p>

<p>Sub-Clause 8.1 Commencement of Work</p>	<p>The Sub- Clause is replaced in its entirety with the following:</p> <p>“The Engineer shall give a Notice to the Contractor stating the Commencement Date, not less than 07 days before the Commencement Date.</p> <p>The Notice shall be issued promptly after the Engineer determines the fulfilment of the following conditions:</p> <ul style="list-style-type: none"> (a) signature of the Contract Agreement by both Parties, and if required, approval of the Contract by relevant authorities of the Country; (b) delivery to the Contractor of reasonable evidence of the Employer’s financial arrangements (under Sub-Clause 2.4 [Employer’s Financial Arrangements]); (c) except if otherwise specified in the Contract Data, effective access to and possession of the Site given to the Contractor together with such permission(s) under (a) of Sub-Clause 1.13 [Compliance with Laws] as required for the commencement of the Works; <p>Subject to Sub-Clause 4.1 on the Management Strategies and Implementation Plans and the C-ESMP and Sub-Clause 4.8 on the health and safety manual, the Contractor, shall commence the execution of the Works as soon as is reasonably practicable after the Commencement Date, and shall then proceed with the Works with due expedition and without delay.”</p>
<p>Sub-Clause 8.2 Time for Completion</p>	<p>The following paragraph shall be added at the end of Sub-Clause 8.2:</p> <p>The Contractor shall complete each Key Date (if any) within the Time for Completion for the Key Date (as the case may be), including completing all work which is stated in the Contract as being required for the Key Date to be considered to be completed for the issuance of key date completion certificate.</p>
<p>Sub-Clause 8.3 Programme</p>	<p>Replace the first sentence of the of the first paragraph of Sub-Clause 8.3 with the following:</p> <p>The Contractor shall submit an Initial Programme for the execution of the Works to the Engineer within 28 days after issue of Letter of Acceptance.</p>
<p>Sub-Clause 8.5 Extension of Time for Completion</p>	<p>Replace the entire first paragraph of Sub-Clause 8.5 with the following:</p>

	<p>The Contractor shall be entitled subject to Sub-Clause 20.1 [Claims] to an extension of the Time for Completion if and to the extent that completion for the purpose of Sub-Clause 10.1 [Taking Over of the Works and Sections] or for the completion of Key Date specified in Appendix 15, Section VII-1: General Specifications, Part 2 Employer's requirements is or will be delayed by any of the following causes:"</p>
<p><i>Sub-Clause 8.8 Delay Damages</i></p>	<p>Replace the entire Sub-Clause 8.8 with the following:</p> <p>If the Contractor fails to comply with Sub-Clause 8.2 [Time for Completion], the Contractor shall subject to notice under Sub-Clause 20.1 Claims] pay delay damages to the Employer for this default. These delay damages shall be the sum stated in the Contract Data, which shall be charged for every week of delay or part thereof which shall elapse between the Time for Completion and actual Date of Completion of the Works.</p> <p>These delay damages shall be the only damages due from the Contractor for such default, other than in the event of termination under Sub-Clause 15.2 [Termination for Contractor's Default] prior to completion of the Works. These damages shall not relieve the Contractor from his obligation to complete the Works, or from any other duties, obligations or responsibilities which he may have under the Contract.</p> <p>Delay Damages may be recovered by the Employer from any amount of money due from the Contractor under the Contract. The Delay Damages may also be recovered from the amount of Performance Security Bank Guarantee and in that case the Contractor would be liable to replenish the amount of Performance Security Bank Guarantee.</p>
<p>Sub-Clause 11.7 Right of Access after Taking Over</p>	<p>In the second paragraph, "Whenever the Contractor intends to access any part of the Works during the relevant DNP:" is replaced with:</p>

	“Whenever, until the date 28 days after issue of the Performance Certificate, the Contractor intends to access any part of the Works:”
Sub-Clause 13.2 Value Engineering	Not applicable
Sub-Clause 13.3.1 Variation by Instruction	Subparagraph 13.3.1 (a) is replaced with: “a description of the varied work performed or to be performed, including details of the resources and methods adopted or to be adopted by the Contractor, and sufficient ESHS information to enable an evaluation of ESHS risks and impacts;”
<i>Sub-Clause 13.3.1 Variation by Instruction</i>	<p><i>Following is added at the end of Sub-Clause 13.3.1.</i></p> <p><i>Variation in the Accepted Contract Amount & deriving rates of new items</i></p> <p><i>A. Variations in Price Schedule ‘A’ and Price Schedule ‘B’ shall be paid as follows:</i></p> <p><i>(I) Schedule ‘A’</i></p> <p><i>Total Scope of OHE works under Schedule ‘A’ is 304 TKM. Accepted Contract Amount under Schedule ‘A’ shall be adjusted for any variation in the total Scope of OHE works on either side (i.e. increase or decrease in OHE TKM). Any increase/decrease per TKM of OHE works shall be paid/recovered at the rate of INR (0.5587xLS) /304.</i></p> <p><i>where, LS = Total lump sum accepted cost of Works for Schedule ‘A’.</i></p> <p><i>Measurement of OHE TKM shall be done as per the methodology specified in Drawing No. GC-HRIDC-SYS1-DRW-ELE-008_A1 Section VII-3: Tender Drawings, Part 2-Employer’s Requirements.</i></p> <p><i>(II) Schedule ‘B’</i></p> <p><i>The quantities of items shown in Schedule ‘B’ are approximate, and are liable to vary during actual execution of the work. Some items may have to be added or deleted. The Contractor shall be bound to carry out and complete the Works as instructed by the Engineer, irrespective of the magnitude of variations including additions or deletion in the Schedule ‘B’. Variations in Schedule ‘B’ shall be paid as follows:</i></p> <p><i>a) At the accepted rates of the Contract for positive variation in quantities of items to the extent of 50%. In case of variation in quantities on minus side, Contract rates will be payable at the accepted rates of the Contract for the executed quantities.</i></p>

	<p>b) <i>In case the Variation in individual items (except for items under Para c), below) as stipulated above is more than 50% on plus side, the rate for the varied quantity beyond 50% shall be negotiated between the Engineer and the Contractor and mutually agreed rates arrived at before execution of the extra quantity.</i></p> <p>c) <i>Variation in the quantity of items individually costing upto 1% of Accepted Contract Amount less provisional sum (i.e. total of Schedule 'A' and Schedule 'B') or Rs. 1 crore, whichever is less, shall be payable at the accepted rates of the Contract, till the value of such individual item on account of Variation reaches upto 2% of the Accepted Contract Amount less provisional sum or Rs. 2 crore, whichever is less. Negotiation of rates for such items shall be conducted only for the exceeded quantity beyond 2% of the Accepted Contract Amount or Rs. 2 crore, whichever is less.</i></p> <p>d) <i>Deriving Rates for New Items / Negotiation</i></p> <p><i>In case Engineer introduces an item for which the Contract does not contain any rates or prices applicable to the varied Works, the rate of such items shall be derived, wherever possible, from rate for similar items available in the Price Schedules of the Accepted Contract Amount. In case this is not possible, the rate shall be decided on the following basis:</i></p> <p>i) <i>Cost of Materials at current market price, as actually utilized in the final finished Permanent Works, including a reasonable percentage for wastage and transportation.</i></p> <p>ii) <i>Cost of enabling works if any (unless provided for separately) worked out on the above basis but with less stringent quality. Specifications minus salvage value of serviceable material released after completion of Work and cost of material released as scrap.</i></p> <p>iii) <i>Cost of labour actually used at the site of Work at rates under Payment of Minimum Wages Act for the area of Work for each category of worker, further enhanced by a percentage of 10% of the aforesaid rates to account for labour not directly utilized at Site and other ancillary and incidental expenses on labour.</i></p>
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	<p>iv) <i>Hire charges for Plant & Machinery, scaffolding, shuttering, forms, etc., required to be used at the site of the work. The tools used by the various trades shall not be counted as Plant & Machinery for this purpose.</i></p> <p>v) <i>An amount of 15% of items d) (i), (ii), (iii) and (iv) above to allow for Contractor's overheads including water/electricity charges and labour cess etc., profits and corporate taxes etc. No such percentage shall be applicable to the estimated cost of Materials supplied free of cost to the Contractor.</i></p> <p>vi) <i>In all cases where extra items of Work are involved, for which there are no rates in the Accepted Contract Amount, the Contractor shall give a notice to the Engineer, of at least 7 days before the need for its execution arises.</i></p> <p>B. Disagreement in Rates for New Items / Negotiation</p> <p><i>In the event of disagreement of rates of new items/negotiations in respect of items A (II) d) above, the Engineer shall fix such rates of price as are, in his opinion appropriate and shall notify the Contractor accordingly, with a copy to the Employer. Until such time as rates or prices are agreed or fixed, the Engineer shall determine provisional rates or prices to enable on-account payments to the Contractor. Alternatively, in the event of disagreement, the Contractor shall have no claim to execute extra quantities/new items and the Engineer shall be free to get such additional quantities beyond 50% / new items executed through any other Agency. However, if the Engineer or the Employer so directs the Contractor shall be bound to carry out any such additional quantities beyond the limits stated above original quantities and/or new items and the disagreement or the difference regarding rates to be paid for the same shall be settled in the manner laid down under the conditions for the settlement of dispute.</i></p>
<p>Sub-Clause 13.4 Provisional Sums</p>	<p>The following is inserted as the penultimate paragraph:</p> <p>“The Provisional Sum shall be used to cover the Employer's share of the DAAB members’ fees and expenses, in accordance with Clause 21. No prior instruction of the Engineer shall be required with respect to the work of the DAAB. The Contractor shall submit the DAAB members’ invoices and satisfactory evidence of having paid 100% of such invoices as part of the substantiation of those Statements submitted under Sub-Clause 14.3.</p>

<p>Sub-Clause 13.6 Adjustments for Changes in Laws</p>	<p>The following paragraph is added at the end of the Sub-Clause:</p> <p>“Notwithstanding the foregoing, the Contractor shall not be entitled to an extension of time if the relevant delay has already been taken into account in the determination of a previous extension of time and such Cost shall not be separately paid if the same shall already have been taken into account in the indexing of any inputs to the Table of Adjustment Data in accordance with the provisions of Sub-Clause 13.7 [Adjustments for Changes in Cost].”</p>
<p>Sub-Clause 13.7 Adjustments for Changes in Cost</p>	<p>The following paragraph is added at the end of Sub-Clause 13.7</p> <p>Price adjustment will also be applicable during the extended period of Time for Completion where such extension has been granted under Sub-Clause 8.5 [Extension of Time for Completion] or it is specifically mentioned that extension is with Price Adjustment.</p>
<p>Part 3, Section IX Particular Conditions of Contract (PCC), Sub-Clause 14.1 (b)</p>	<p>Add the following at the end of Sub-Clause 14.1</p> <p><i>All Goods imported by the Contractor into the Country shall be exempt from customs and other import duties as per the provision of the Notification No. 84/97 dated 11th Nov 1997, as amended from time to time (Copy of Notification is enclosed as Annexure A of PCC Part B-Specific Provisions). The Employer shall endorse the necessary exemption documents prepared by the Contractor for presentation in order to clear the Goods through Customs.</i></p> <p><i>If an exemption is not granted, the customs duties payable and paid shall be reimbursed by the Employer on submission of documentary evidence by the Contractor.</i></p> <p><i>All imported Goods, which are not incorporated in or expended in connection with the Works, shall be exported on completion of the Contract. If not exported, the Goods will be assessed for duties as applicable to the Goods involved in accordance with the Laws of the Country.</i></p> <p><i>However, exemption may not be available for:</i></p> <p><i>(a) Goods which are similar to those locally produced, unless they are not available in sufficient quantities or are of a different standard to that which is necessary for the Works; and</i></p> <p><i>(b) any element of duty or tax inherent in the price of goods or services procured in the Country, which shall be deemed to be included in the Accepted Contract Amount.</i></p>

	<p><i>Port dues, quay dues and, except as set out above, any element of tax or duty inherent in the price of goods or services shall be deemed to be included in the Accepted Contract Amount.”</i></p>
<p>Sub-Clause 14.2.1 Advance Payment Guarantee</p>	<p>Replace the first para of Sub-Clause 14.2.1 with the following:</p> <p>The Contractor shall obtain (at the Contractor’s cost) an Advance Payment Guarantee or Security in amounts and currencies equal to the advance payment and shall submit it to the Employer with a copy to the Engineer. The Guarantee in accordance to the form attached to the Contract can be split up in four (4) Guarantees to be released on repayment. The Contractor shall submit the Advance Payment Guarantee in any of the following forms:</p> <p>(a) Unconditional and irrevocable Bank Guarantee from the specified banks in the form appearing in Section X [Contract Forms] as under:</p> <ul style="list-style-type: none"> (i) a scheduled bank (excluding co-operative banks) in India, or (ii) a Foreign Bank having arrangement with a nationalized bank or scheduled banks (excluding co-operative banks) in India; <p>(b) Banker's Cheque or Demand Draft drawn on a scheduled bank (excluding co-operative banks) or nationalized bank in India.</p> <p>The scheduled bank issuing the bank guarantee shall be on “Structure Financial Messaging System (SFMS)” platform. A separate advice of the bank guarantee shall invariably be sent by the issuing bank to Employer’s Bank through SFMS at the address given below and only after receipt of the same by the Employer’s Bank, the bank guarantee shall become operative and acceptable to the Employer. Further, the bank guarantees in original form along with a copy of “MT760COV (in case of bank guarantee message)/ MT767COV (in case of bank guarantee amendment message) Report” sent by the concerned issuing bank sealed in an envelope shall be submitted to the Employer.</p>

	<p>The Issuing Bank shall send the SFMS to:</p> <p>Beneficiary: Haryana Orbital Rail Corporation Limited</p> <p>Bank Name:</p> <p>Account No.</p> <p>IFSC Code:</p> <p>Note: All the instruments mentioned in (a) & (b) above should be in favour of Haryana Orbital Rail Corporation Limited, Plot No 143, 5th Floor, Railtel Tower, Sector-44, Gurugram.</p> <p>Such Advance Payment guarantee shall remain effective until the Advance Payment has been repaid pursuant to provision of this Sub-Clause 14.2, but the amount thereof shall be progressively reduced by the amount repaid by the Contractor as indicated in the Interim Payment Certificate issued in accordance with this Clause 14.</p>
<p>Sub-Clause 14.2.3 Repayment of Advance Payment</p>	<p>Replace the Sub-Clause 14.2.3 with the following:</p> <p>a. The recovery of Advances shall commence when 30% of the Accepted Contract Amount of the Work has been paid and it will be completed by the time, 90% of the Accepted Contract Amount has been paid or the original completion date whichever is earlier. However, minimum recovery of advances shall be at the rate of 10% (ten percent) of on-account bill.</p> <p>b. The Contractor shall always have the option to have the recoveries commenced and/or completed earlier, and/or to have recoveries affected in installments of higher amount and also to repay part or whole of the Advance by direct payment rather than through on-account Bills. However, the recovery of Advances shall be limited to 30% of on-account bill.</p> <p>c. In case the Contract is terminated due to default of the Contractor or rescinded / foreclosed, due to any other reason, the Contractor shall return the unrecovered amount of all Advances within 15 days of issue of notice of termination / rescission / foreclosure of the Contract and if the Contractor fails to do so due to any reason whatsoever, then interest at rate equal to State Bank of India's Marginal Cost of fund based Lending Rate (MCLR) applicable for the tenure of 01 year prevailing on the date of issue of notice of</p>

	<p>termination / rescission / foreclosure plus 3% Penal Interest per annum shall be charged on the unrecovered amount of such Advances from 16th day onwards compounded quarterly till the same is returned by the Contractor.</p> <p>Interest in case of Delay in repayment of Advances Should there be delay in the progress and completion of Work on account of Contractor, as a result of which it is not possible to recover the Advances and interest thereon, before the date of completion stipulated in the Contract, then the interest to be charged from the Contractor on the remaining portion of the Advances beyond the original completion date specified in the Contract, shall be equal to State Bank of India's Marginal Cost of fund based Lending Rate (MCLR) applicable for the tenure of 01 year prevailing on the original completion date specified in the Contract plus 3% Penal Interest per annum.</p> <p>Advances to be used only for this work The advances shall be used by the Contractor strictly for the purpose of the Contract, and for the purpose for which they are paid. Under no circumstances, shall the advances be diverted for other purposes. Any such diversion shall be construed as a breach of the Contract and the Contractor shall be asked to return the advance at once and pay interest at 15% per annum till the advance is recovered back from the Contractor. The Contractor shall return the advance and pay the interest in one go without demur. Employer retains the right for any other remedy prescribed for breach of Contract in this regard.</p>
<p>Sub-Clause 14.3 Application for Interim Payment</p>	<p>The following is inserted at the end of (vi) after: <i>[Agreement or Determination]</i>: "any reimbursement due to the Contractor under the Dispute Avoidance/ Adjudication Agreement. (Appendix General Conditions of Dispute Avoidance/ Adjudication Agreement)."</p>
<p>Sub-Clause 14.3 Application for Interim Payment</p>	<p>Add the following at the end, below Sub paragraph '(x)'</p> <p>(xi) an amount to be deducted for the payments demanded by relevant competent authorities of the Central Government and/or State Government and/or local bodies from the Employer as due payments/ liability of the Contractor as mandated by relevant laws. (xii) Stage Completion/Milestone Certificate issued by the Engineer.</p>

<p>Sub-Clause 14.6.1 The IPC</p>	<p>Replace the Sub-Clause 14.6.1 with the following:</p> <p>The Engineer shall, within 03 business days after receiving a Statement and supporting documents from the Contractor, issue an IPC to the Employer, with a copy to the Contractor:</p> <p>(a) stating the amount which the Engineer fairly considers to be due; and</p> <p>(b) including any additions and/or deductions which have become due under Sub-Clause 3.7 [Agreement or Determination] or under the Contract or otherwise, with detailed supporting particulars (which shall identify any difference between a certified amount and the corresponding amount in the Statement and give the reasons for such difference).</p>
<p>Sub-Clause 14.6.2 Withholding (amounts in) an IPC</p>	<p>“and/or” from subparagraph (b) is deleted.</p> <p>The following is then added as subparagraph (c) and subparagraph (c) of the Sub-Clause is renumbered as (d):</p> <p>“(c) if the Contractor was, or is, failing to perform any ESHS obligations or work under the Contract, the value of this work or obligation, as determined by the Engineer, may be withheld until the work or obligation has been performed, and/or the cost of rectification or replacement, as determined by the Engineer, may be withheld until rectification or replacement has been completed. Failure to perform includes, but is not limited to the following:</p> <ul style="list-style-type: none"> (i) failure to comply with any ESHS obligations or work described in the Works’ Requirements which may include: working outside site boundaries, excessive dust, damage to offsite vegetation, pollution of water courses from oils or sedimentation, contamination of land e.g. from oils, human waste, damage to archaeology or cultural heritage features, air pollution as a result of unauthorized and/or inefficient combustion; (ii) failure to regularly review C-ESMP and/or update it in a timely manner to address emerging ESHS issues, or anticipated risks or impacts; (iii) failure to implement the C-ESMP e.g. failure to provide required training or sensitization;

	<p>(iv) failing to have appropriate consents/permits prior to undertaking Works or related activities;</p> <p>(v) failure to submit ESHS report/s (as described in general specifications, or failure to submit such reports in a timely manner;</p> <p>(vi) failure to implement remediation as instructed by the Engineer within the specified timeframe (e.g. remediation addressing non-compliance/s).”</p>
<p>Sub-Clause 14.7 Payment</p>	<p>At the end of sub-paragraph (b): “and” is replaced with “or” and the following inserted as (iii):</p> <p>“(iii) at a time when the Bank’s loan (from which part of the payments to the Contractor is being made) is suspended, the amount shown on any statement submitted by the Contractor within 14 days after such statement is submitted, any discrepancy being rectified in the next payment to the Contractor; and”</p> <p>At the end of sub-paragraph (c): “.” is replaced with “;” and the following inserted:</p> <p>“or, at a time when the Bank’s loan (from which part of the payments to the Contractor is being made) is suspended the undisputed amount shown in the Final Statement within 56 days after the date of notification of the suspension in accordance with Sub-Clause 16.2 [Termination by Contractor].”</p>

<p>Sub-Clause 14.7 Payment</p>	<p>After the sub-paragraphs (c), add (d) with the following:</p> <p>(d) Provisional amount against the Statement specified in Sub-Clause 14.3:</p> <p>i) The Employer shall pay 80% of such amount as provisional payment within 4 business days from the receipt of IPC from the Engineer. The balance 20% shall be paid within 28 days from the receipt of evaluated statement from the Engineer. Next 80% amount of provisional payment shall be made only after 100% payment of preceding interim payment certified has been completed.</p> <p>ii) It shall be the responsibility of the Contractor to claim an amount for the performed services as admissible as per the Contract. If at any time it is observed by the Engineer that the amount claimed in the Statement are higher than the actual admissible performance, the facility of provisional payment will be withheld until such time the excess payment paid is adjusted in the subsequent Interim Payment Certificate. In such a case, warning letter will be issued to the Contractor.</p> <p>iii) If at any time, the Engineer/Employer observes for the second time that the amount claimed in the Statement are higher than the actual admissible performance, the facility of provisional payment will be liable to be withdrawn.</p> <p>(e) Payment of GST:</p> <p>The Contractor is responsible for paying all the taxes [including Goods and Service Tax (GST)], duties, cess, etc. as per the Statutory requirements. However, GST levied on the invoices raised by the Contractor will be temporarily withheld at the time of making payment for the invoice.</p> <p>GST withheld will be released by HRIDC/ HORCL on submission of proof, i.e. copy of Form GSTR-1 (reflecting the particular invoice) after due verification from the GST portal by the Employer.</p>
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<p>Sub-Clause 14.9 Release of Retention Money</p>	<p>The following is added at the end of Sub-Clause 14.9:</p> <p>“Unless otherwise stated in the Contract, when the Taking-Over Certificate has been issued for the Works and the first half of the Retention Money has been certified for payment by the Engineer, the Contractor shall be entitled to substitute a guarantee, in the form annexed to the Particular Conditions of Contract or in another form approved by the Employer for the second half of the Retention Money. The Contractor shall submit unconditional and irrevocable Bank Guarantee from the specified banks in the form appearing in Section X [Contract Forms] as under:</p> <p style="padding-left: 40px;">(i) a scheduled bank (excluding co-operative banks) in India, or</p> <p style="padding-left: 40px;">(ii) a Foreign Bank having arrangement with a nationalized bank or scheduled banks (excluding co-operative banks) in India;</p> <p>The scheduled bank issuing the bank guarantee shall be on “Structure Financial Messaging System (SFMS)” platform. A separate advice of the bank guarantee shall invariably be sent by the issuing bank to Employer’s Bank through SFMS at the address given below and only after receipt of the same by the Employer’s Bank, the bank guarantee shall become operative and acceptable to the Employer. Further, the bank guarantees in original form along with a copy of “MT760COV (in case of bank guarantee message)/ MT767COV (in case of bank guarantee amendment message) Report” sent by the concerned issuing bank sealed in an envelope shall be submitted to the Employer.</p> <p>The Issuing Bank shall send the SFMS to:</p> <p>Beneficiary: Haryana Orbital Rail Corporation Limited</p> <p>Bank Name:</p> <p>Account No.</p> <p>IFSC Code:</p>
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	<p>Note: Bank Guarantee should be in favour of Haryana Orbital Rail Corporation Limited, Plot No 143, 5th Floor, Railtel Tower, Sector-44, Gurugram.</p> <p>The Contractor shall ensure that the guarantee is in the amounts and currencies of the second half of the Retention Money and is valid and enforceable until the Contractor has executed and completed the Works and remedied any defects, as specified for the Performance Security in Sub-Clause 4.2. On receipt by the Employer of the required guarantee, the Engineer shall certify, and the Employer shall pay the second half of the Retention Money. The release of the second half of the Retention Money against a guarantee shall then be in lieu of the release after the latest of the expiry dates of the Defects Notification Periods. The Employer shall return the guarantee to the Contractor within 21 days after receiving a copy of the Performance Certificate.</p> <p>If the Performance Security required under Sub-Clause 4.2 is in the form of a demand guarantee, and the amount guaranteed under it when the Taking-Over Certificate is issued is more than half of the Retention Money, then the Retention Money guarantee will not be required. If the amount guaranteed under the Performance Security when the Taking-Over Certificate is issued is less than half of the Retention Money, the Retention Money guarantee will only be required for the difference between half of the Retention Money and the amount guaranteed under the Performance Security.”</p>
<p>Sub-Clause 14.12 Discharge</p>	<p>On the seventh line of the first paragraph, “Sub-Clause 21.6 [<i>Arbitration</i>]” is replaced with: “Clause 21 [<i>Disputes and Arbitration</i>]”.</p>
<p>Sub-Clause 14.15 Currencies of Payment</p>	<p>Throughout Sub-Clause 14.15, “Contract Data” is replaced with: “Schedule of Payment Currencies”.</p>
<p>Sub-Clause 15.1 Notice to Correct</p>	<p>“and” is deleted from (b) and</p> <p>“.” is replaced by: “; and” in (c).</p> <p>The following is then added as (d)</p> <p>“(d) specify the time within which the Contractor shall respond to the Notice to Correct.”</p>

	In the third para., “shall immediately respond” is replaced with: “shall respond within the time specified in (d)”. Further, in the third para., “to comply with the time specified in the Notice to Correct.” is replaced with: “to comply with the time specified in (c).”
Sub-Clause 15.2.1 Notice	Sub-paragraph (h) is replaced with: “based on reasonable evidence, has engaged in Prohibited Practice as defined in paragraph 2 of the Particular Conditions - Part C –Prohibited Practices, in competing for or in executing the Contract.”
Sub-Clause 15.8 Part(s) termination of the Contract	Add New Sub-Clause 15.8 “ Part(s) termination of the Contract ” after Sub-Clause 15.7; For Part(s) termination of the Contract If the Contractor fails to demonstrate to the satisfaction of Engineer that they will be able to achieve a specified Key Date(s)/Date of Completion/ remedying any notified defect under the contract, the Engineer may give the Contractor a notice to correct under Sub-Clause 15.1 in writing to expedite such identified work(s) immediately, so as to achieve the Key Date(s)/Date of Completion/ remedying any notified defect under the contract. If the Contractor fails to comply with such notice, the Employer, in his sole discretion, shall be entitled to carry out such identified part of works (Maximum upto 10% original Accepted Contract Amount) under Sub Clause 13.1 (Right to vary) as is necessary to achieve the key Date(s)/Date of completion by his own workmen or by other contractors without prejudice to any other right or remedy(ies). Engineer shall proceed in accordance with Sub clause 3.7.2 (Engineer’s Determination) the value of the part work(s) decided to be part terminated. The Engineer shall as soon as practicable after taking such decision, notify the Contractor thereof in writing of the value of the identified Works for the encashment of Performance Security as specified in Sub clause 15.4
Sub-Clause 15.9 Prohibited Practices	Add New Sub-Clause 15.9 “Prohibited Practices” after Sub-Clause 15.8; “ 15.9.1 The Bank requires compliance with the Bank’s Policy on Prohibited Practices as set forth in Particular Conditions - Part C- Prohibited Practices.

	<p>15.9.2 The Employer requires the Contractor to disclose any commissions or fees that may have been paid or are to be paid to agents or any other party with respect to the tendering process or execution of the Contract. The information disclosed must include at least the name and address of the agent or other party, the amount and currency, and the purpose of the commission, gratuity or fee.”</p>
<p>Sub-Clause 16.1 Suspension by Contractor</p>	<p>The following paragraph is inserted after the first paragraph:</p> <p>“Notwithstanding the above, if the Bank has suspended disbursements under the loan from which payments to the Contractor are being made, in whole or in part, for the execution of the Works, and no alternative funds are available as provided for in Sub-Clause 2.4 [Employer’s Financial Arrangements], the Contractor may by notice suspend work or reduce the rate of work at any time, but not less than 7 days after the Recipient having received the suspension notification from the Bank.”</p>
<p>Sub-Clause 16.2.1 Notice</p>	<p>Sub-paragraph (j) is deleted in its entirety.</p> <p>At the end of sub-paragraph (i): “; or” is replaced with: “.”</p> <p>sub-paragraph (f) is replaced with:</p> <p>“(f) the Contractor does not receive a Notice of the Commencement Date under Sub-Clause 8.1 [<i>Commencement of Works</i>] within 180 days after receiving the Letter of Acceptance, for reasons not attributable to the Contractor.”</p>
<p>Sub-Clause 16.2.2 Termination</p>	<p>The following is added at the end of Sub-Clause 16.2.2:</p> <p>“In the event the Bank suspends the loan from which part or whole of the payments to the Contractor are being made, if the Contractor has not received the sums due to him upon expiration of the 14 days referred to in Sub-Clause 14.7 [Payment] for payments under Interim Payment Certificates, the Contractor may, without prejudice to the Contractor's entitlement to financing charges under Sub-Clause 14.8 [Delayed Payment], take one of the following actions, namely (i) suspend work or reduce the rate of work under Sub-Clause 16.1 above, or (ii) terminate the Contract by giving notice to the Employer, with a copy to the Engineer, such termination to take effect 14 days after the giving of the notice.”</p>

Sub-Clause 17.1 Responsibility for Care of the Works	On the fourth and fifth lines of the first paragraph, replace “Date of Completion of the Works” with “issue of the Taking-Over Certificate for the Works”.
Sub-Clause 17.3 Intellectual and Industrial Property Rights	On the first line of the second paragraph, replace “notice” is replaced with “a Notice”.
Sub-Clause 17.4 Indemnities by the Contractor	Replace the sub-paragraph 17.4(b) (i) of Sub-Clause 17.4 with the following: (i) arises out of or in the course of or by reason of the design, execution, completion and the remedying of any defects of the Works, and
Sub-Clause 17.7 Use of Employer’s Accommodation/Facilities	The following Sub-Clause is added as 17.7: “The Contractor shall take full responsibility for the care of the Employer-provided accommodation and facilities, if any, as detailed in the Employer’s Requirements, from the respective dates of hand-over to the Contractor until cessation of occupation (where hand-over or cessation of occupation may take place after the date stated in the Taking-Over Certificate for the Works) If any loss or damage happens to any of the above items while the Contractor is responsible for their care arising from any cause whatsoever other than those for which the Employer is liable, the Contractor shall, at its own cost, rectify the loss or damage to the satisfaction of the Engineer.”
Sub-Clause 18.1 Exceptional Events	Sub-paragraph (c) is substituted with: “(c) riot, commotion, disorder or sabotage by persons other than the Contractor’s Personnel and other employees of the Contractor and Subcontractors;”
Sub-Clause 18.4 Consequences of an Exceptional Event	The following is added at the end of sub-paragraph (b) after deleting the “.”: “, including the costs of rectifying or replacing the Works and/or Goods damaged or destroyed by Exceptional Events, to the extent they are not indemnified through the insurance policy referred to in Sub-Clause 19.2 [Insurance to be provided by the Contractor].”
Sub-Clause 18.5 Optional Termination	In sub-paragraph (c), “and necessarily” is inserted after “was reasonably”.

<p>Sub-Clause 19.1 General Requirements</p>	<p>The following paragraphs are added after the first:</p> <p>“Wherever the Employer is the insuring Party, each insurance shall be effected with insurers and in terms acceptable to the Contractor. These terms shall be consistent with terms (if any) agreed by both Parties before the date of the Letter of Acceptance.</p> <p>This agreement of terms shall take precedence over the provisions of this Clause.”</p>
<p>Sub-Clause 19.2 Insurance to be provided by the Contractor</p>	<p>The following is inserted as the first sentence in Sub-Clause 19.2:</p> <p>“The Contractor shall be entitled to place all insurances relating to the Contract (including, but not limited to the insurance referred to Clause 19) with insurers from any eligible source country through an insurance provider that is authorized to provide such insurance coverage in India.</p> <p>The Contractor shall submit all evidence(s) of insurances and policies within the period stated in the Contract Data.”</p>
<p>Sub-Clause 19.2.1 The Works</p>	<p>On the last line of the second paragraph, “Clause 12 [<i>Tests after completion</i>]” is deleted.</p>
<p>Sub-Clause 19.2.5 Injury to employees</p>	<p>The second paragraph is replaced with:</p> <p>“The Employer and the Engineer shall also be indemnified under the policy of insurance, against liability for claims, damages, losses and expenses (including legal fees and expenses) arising from injury, sickness, disease or death of any person employed by the Contractor or any other of the Contractor’s Personnel, except that this insurance may exclude losses and claims to the extent that they arise from any act or neglect of the Employer or of the Employer’s Personnel.”</p>
<p>Sub-Clause 20.1 Claims</p>	<p>In a): “any additional payment” is replaced with “payment”.</p>
<p>Sub-Clause 20.2 Claims for Payment and/or EOT</p>	<p>The first paragraph is replaced with:</p> <p>“If either Party considers that it is entitled to claim under 20.1 (a) or (b), the following claim procedure shall apply:”</p>

<p>Sub-Clause 21.1</p> <p>Constitution of the DAAB</p>	<p>Replace the entire first paragraph of Sub-Clause 21.1 with the following:</p> <p>Dispute shall be referred to a DAAB for decision in accordance with Sub-Clause 21.4 [Obtaining DAAB’s Decision]. The Parties shall appoint a DAAB by the date stated in the Contract Data. The date may be changed if both the Parties agree, in writing, to change the date, up to one hundred eighty (180) days after the Commencement Date.</p> <p>In the second paragraph, at the end of the first sentence after deleting: “.”, the following is added: “, each of whom shall meet the criteria set forth in Sub-Clause 3.3 of Appendix- General Conditions of Dispute Avoidance/ Adjudication Agreement.”</p> <p>After the second paragraph insert the following paragraph: “If the Contract is with a foreign Contractor, the DAAB members shall not have the same nationality as the Employer or the Contractor.”</p>
<p>Sub-Clause 21.2</p> <p>Failure to Appoint DAAB Member(s)</p>	<p>For both (a) and (b): “by the date stated in the first paragraph of Sub-Clause 21.1 [<i>Constitution of the DAAB</i>]” is replaced with: “within 42 days from the date the Contract is signed by both Parties”</p>

<p>Sub-Clause 21.6 Arbitration</p>	<p>This clause stands amended and restated in its entirety as follows:</p> <p>21.6.1 Disputes shall be settled by arbitration in accordance with the following provisions:</p> <p>(A) In case of the Contractor or the Lead member of the Contractor (in the case of a Joint Venture or Consortium) being of foreign origin</p> <p>If the efforts to resolve all or any of the disputes through amicable settlement fails, then such disputes or differences, whatsoever arising between the parties, arising out of the Contract or relating to effect of the Contract or the breach thereof shall be referred to Arbitration in accordance with the following provisions:</p> <p>1. Selection of Arbitrators -Each dispute submitted by a Party to arbitration shall be heard by a sole arbitrator or an arbitration panel comprising three (3) arbitrators, in accordance with the following provisions:</p> <p>(a) Where the Parties agree that the dispute concerns a technical matter, they may agree to appoint a sole arbitrator or, failing agreement on the identity of such sole arbitrator within thirty (30) days after receipt by the other Party of the proposal of a name for such an appointment by the Party who initiated the proceedings, either Party may apply to Singapore International Arbitration Centre (SIAC) for a list of not fewer than five (5) nominees and, on receipt of such list, the Parties shall alternately strike names therefrom, and the last remaining nominee on the list shall be the sole arbitrator for the matter in dispute. If the last remaining nominee has not been determined in this manner within sixty (60) days of the date of receipt of the list by the Parties, SIAC shall appoint, upon the request of either Party and from such list or otherwise, a sole arbitrator for the matter in dispute.</p> <p>(b) Where the Parties do not agree that the dispute concerns a technical matter, the Client and the Contractor shall each appoint one (1) arbitrator, and these two arbitrators shall jointly appoint a third arbitrator, who shall chair the arbitration panel. If the arbitrators named by the Parties do not succeed in appointing a third arbitrator within thirty (30) days after the</p>
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	<p>latter of the two (2) arbitrators named by the Parties has been appointed, the third arbitrator shall, at the request of either Party, be appointed by SIAC.</p> <p>(c) If, in a dispute subject to paragraph (b) above, one Party fails to appoint its arbitrator within thirty (30) days after the other Party has appointed its arbitrator, the Party which has named an arbitrator may apply to the SIAC to appoint a sole arbitrator for the matter in dispute, and the arbitrator appointed pursuant to such application shall be the sole arbitrator for that dispute.</p> <p>2. Rules of Procedure - Except as otherwise stated herein, arbitration proceedings shall be conducted in accordance with the rules of procedure for arbitration of the United Nations Commission on International Trade Law (UNCITRAL) as in force on the date of this Contract.</p> <p>3. Substitute Arbitrators -If for any reason an arbitrator is unable to perform his/her function, a substitute shall be appointed in the same manner as the original arbitrator.</p> <p>4. Nationality and Qualifications of Arbitrators - The sole arbitrator or the third arbitrator appointed pursuant to paragraphs 1(a) through 1(c) above shall be an internationally recognized legal or technical expert with extensive experience in relation to the matter in dispute and shall not be a national of the Contractor's home country or of the Employer's home country or of the home country of any of their members or Parties or of the Government's country. For the purposes of this Clause, "home country" means any of:</p> <p>(a) the country of incorporation of the Contractor or of any of their members or Parties; or</p> <p>(b) the country in which the Contractor's or any of their members' or Parties' principal place of business is located; or</p> <p>(c) the country of nationality of a majority of the Contractor's or of any members' or Parties' shareholders; or</p> <p>(d) the country of nationality of the Sub-Contractor concerned, where the dispute involves a subcontract.</p>
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	<p>5. Miscellaneous - In any arbitration proceeding hereunder:</p> <p>(a) proceedings shall, unless otherwise agreed by the Parties, be held at Gurugram, India or such place as mutually agreed by both parties. The cost of Arbitration including the fees of the Arbitrator shall be borne equally by both the parties.</p> <p>(b) the English language shall be the official language for all purposes; and</p> <p>(c) the decision of the sole arbitrator or of a majority of the arbitrators (or of the third arbitrator if there is no such majority) shall be final and binding and shall be enforceable in any court of competent jurisdiction, and the Parties hereby waive any objections to or claims of immunity in respect of such enforcement.</p> <p>(B) In case of the Contractor or the Lead member of the Contractor (in the case of a Joint Venture or Consortium) being of Indian origin</p> <p>If the efforts to resolve all or any of the disputes through amicable settlement fail, then such disputes or differences, whatsoever arising between the parties, arising out of the Contract or relating to effect of the Contract or the breach thereof shall be referred to Arbitration in accordance with the following provisions:</p> <p>(a) The Arbitration proceedings shall be assumed to have commenced from the day, a written and valid demand for arbitration is received by Managing Director of the Employer (MD/HORCL).</p> <p>(b) The disputes so referred to arbitration shall be settled in accordance with the Indian Arbitration & Conciliation Act, 1996 and amended by the Arbitration and Conciliation (Amendment) Act, 2015 and any statutory modification or re-enactment thereof. Further, it is agreed between the parties as under:</p> <p>Number of Arbitrators - The Arbitral tribunal shall consist of 3 (three) arbitrators</p> <p>1. Procedure for Appointment of Arbitrators The arbitrators shall be appointed as per following procedure:</p>
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	<p>a) Within 30 days from the day when a written and valid demand for Arbitration is received by MD/HORCL, the Employer will forward a panel of not fewer than five (05) nominees to the Contractor. The Contractor will then give his consent for any one name out of the panel to be appointed as one of the arbitrators within 30 days of dispatch of the request by the Employer.</p> <p>b) The Employer will decide the second Arbitrator. MD/HORCL shall appoint the two Arbitrators, including the name of one Arbitrator for whom consent was given by the Contractor, within 30 days from the receipt of the consent for one name of the Arbitrator from the Contractor. In case the Contractor fails to give his consent within 30 days of the request of the Employer, MD/HORCL shall nominate both the Arbitrators from the panel. The third Arbitrator shall be chosen by the two Arbitrators so appointed by the parties out of the panel of Arbitrators provided to Contractor or from the larger panel of Arbitrators to be provided to them by the Employer at the request of two appointed Arbitrators (if so desired by them) and who shall act as presiding Arbitrator. In case of failure of the two appointed Arbitrators to reach upon consensus within a period of 30 days from their appointment, then, upon the request of either or both parties, the presiding Arbitrator shall be appointed by the MD/HORCL within 14 days of receipt of request from either party or both parties.</p> <p>c) If one or more of the Arbitrators appointed as above refuses to act as Arbitrator, withdraws from his office as Arbitrator, or vacates his/their office/offices or is/are unable or unwilling to perform his functions as Arbitrator for any reason whatsoever or dies or in the opinion of the MD/HORCL fails to act without undue delay, the MD/HORCL shall appoint new Arbitrator/Arbitrators to act in his/their place except in case of new presiding Arbitrator who shall be chosen following the same procedure as mentioned in para (b) above. Such reconstituted Tribunal may, at its discretion, proceed with the reference from the stage at which it was left by the previous Arbitrator(s).</p> <p>d) The Employer at the time of offering the panel of Arbitrator(s) to be appointed as Arbitrator shall also supply the information with regard to the qualifications of the said Arbitrators nominated in the panel along with their professional experience, phone nos. and addresses to the Contractor. The</p>
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	<p>minimum qualification and experience of the arbitrators which may be appointed by the Parties in accordance with the contract is set out below:</p> <p>(i) A working/retired officer (not below E-8 grade in a central public sector undertaking in India, with which the Employer has no direct business relationship), of engineering or accounts/finance discipline, having experience in management of construction contracts; or</p> <p>(ii) A retired officer (not below the SAG level in Indian Railways) of any Engineering Services of Indian Railways or Indian Railway Accounts Service, having experience in management of construction contracts;</p> <p>2. Miscellaneous: In any arbitration proceeding hereunder:</p> <p>(a) The language of arbitration shall be English. This arbitration shall be governed in accordance with the laws of India.</p> <p>(b) The venue of the arbitration shall be Gurugram, India. The cost of Arbitration including the fees of the Arbitrator shall be borne equally by both the parties.</p> <p>(c) The decision of the majority of the arbitrators (or of the third arbitrator if there is no such majority) shall be final and binding and shall be enforceable in High court at Chandigarh, and the Parties hereby waive any objections to or claims of immunity in respect of such enforcement.</p> <p>21.6.2 In the event that the Contractor wishes to refer a dispute to arbitration in accordance with this Sub-Clause, it shall be required to serve a notice in this regard to the Managing Director, of the Employer for commencement of arbitration.</p> <p>21.6.3 Pending the submission of and/or decision on a dispute and until the arbitral award is published, the Parties shall continue to perform their respective obligations under the contract without prejudice to a final adjustment in accordance with such award.</p> <p>21.6.4 The arbitrators shall have full power to open up, review and revise any certificate, determination, instruction, opinion or valuation of the Engineer, and any decision of the DAAB, relevant to the dispute. Nothing shall disqualify representatives of the Parties and the Engineer from being called as a witness and giving evidence before the arbitrators on any matter</p>
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	<p>whatsoever relevant to the dispute. However, Conciliator cannot be present as a witness by either party in the arbitral proceedings.</p> <p>21.6.5 Neither Party shall be limited in the proceedings before the arbitrators to the evidence or arguments previously put before the DAAB to obtain its decision, or to the reasons for dissatisfaction given in its Notice of Dissatisfaction.</p> <p>21.6.6 Neither party shall be limited in the proceedings before such arbitrators to the evidence or arguments put before the Engineer to obtain his decision. No decision given by the Engineer in accordance with the contract shall disqualify him from being called as a witness and giving evidence before the arbitrators on any matter, whatsoever, relevant to dispute referred to arbitration.</p> <p>21.6.7 Arbitration may be commenced prior to or after completion of the Works. The obligations of the Parties, the Engineer and the DAAB shall not be altered by reason of any arbitration being conducted during the progress of the Works.</p>
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Appendix- General Conditions of Dispute Avoidance/Adjudication Agreement

- Title** “General Conditions of Dispute Avoidance/Adjudication Agreement” is replaced with “General Conditions of DAAB Agreement”.
- 1. Definitions**
- Sub-Clause 1.2: In both the first and third lines, “DAA Agreement” is replaced with “DAAB Agreement”.
- Sub-Clause 1.3:
- In the first line, “Dispute Avoidance/Adjudication Agreement” or “DAA Agreement” means” is replaced with: “DAAB Agreement” is as defined under the Contract and is”.
- In the first line of sub-paragraph (c), “DAA Agreement” is replaced with “DAAB Agreement”.
- In sub-paragraph (c)(ii), “chairman” is replaced with “chairperson”.
- Sub-Clause 1.3 “DAAB Activities” is replaced with Sub-Clause 1.4 “DAAB Activities” and the subsequent Sub-Clauses under Clause 1 “Definitions” renumbered:
- Sub-Clause 1.7 to 12: Replace all instances of “DAA Agreement” with “DAAB Agreement”.
- In Sub-Clause 1.8 a(i):” authorised representative of the contractor or of the Employer” is replaced with: “Contractor’s Representative or authorised representative of the Employer”.
- 3. Warranties**
- Sub-Clause 3.3 is deleted and replaced with the following:
- “When appointing the DAAB Member, each Party relies on the DAAB Member’s representations, that he/she;
- a) has at least a bachelor’s degree in relevant disciplines such as law, engineering, construction management or contract management;
 - b) has at least ten years of experience in contract administration/management and dispute resolution, out

of which at least five years of experience as an arbitrator or adjudicator in construction-related disputes;

- c) has received formal training as an adjudicator from an internationally recognized organization;
- d) has experience and/or is knowledgeable in the type of work which the Contractor is to carry out under the Contract;
- e) has experience in the interpretation of construction and/or engineering contract documents;
- f) has familiarity with the forms of contract published by FIDIC since 1999, and an understanding of the dispute resolution procedures contained therein; and
- g) is fluent in the language for communications stated in the Contract Data (or the language as agreed between the Parties and the DAAB).”

7. Confidentiality

In Sub-Clause 7.3: “or” is deleted after sub-paragraph (b), and the following added:

“or (d) is being provided to the Bank.”

9. Fees and Expenses

In Sub-Clause 9.1 (c): “business class or equivalent” is replaced with: “in less than first class”.

In Sub-Clause 9.4: “and air fares” and “other” are deleted from the first and second sentences respectively.

10. Resignation and Termination

In Sub-Clause 10.3: “the DAA Agreement” is replaced with: “a DAAB member’s DAAB Agreement”.

Annex- DAAB Procedural Rules

Rule 4.2 On the fourth line, “chairman” is replaced with “chairperson”.

Rule 8.3 On the sixth line, “chairman” is replaced with “chairperson”.

Form of Dispute Avoidance/Adjudication Agreement

All instances of “DAA Agreement” are replaced with: “DAAB Agreement”.

In C (b): “chairman” is replaced with “chairperson”.

Particular Conditions of Contract (PCC)

Part C – Prohibited Practices

1. The Bank requires that the Recipient (and all other beneficiaries of the Bank financing), as well as tenderers, suppliers, contractors, concessionaires and consultants under Bank-financed contracts for the Project, observe the highest standard of transparency and integrity during the procurement, execution and implementation of such contracts.
2. Definitions. In pursuance of this policy, the Bank defines the terms set forth below as Prohibited Practices:
 - (a) “**coercive practice**” means impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of a party to influence improperly the actions of a party;
 - (b) “**collusive practice**” means an arrangement between two or more parties designed to achieve an improper purpose, including to influence improperly the actions of another party;
 - (c) “**corrupt practice**” means the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party;
 - (d) “**fraudulent practice**” means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation.
 - (e) “**misuse of resources**” means improper use of the Bank’s resources, carried out either intentionally or through reckless disregard;
 - (f) “**obstructive practice**” means any of the following practices: (i) deliberately destroying, falsifying, altering or concealing of evidence material to a Bank investigation; (ii) making false statements to investigators in order to materially impede a Bank investigation into allegations of a Prohibited Practice; (iii) failing to comply with requests to provide information, documents or records in connection with a Bank investigation; (iv) threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to a Bank investigation or from pursuing the investigation; or (v) materially impeding the exercise of the Bank’s contractual rights of audit or inspection or access to information; and
 - (g) “**theft**” means the misappropriation of property belonging to another party.
3. Any occurrence, or suspected occurrence, of a Prohibited Practice in the procurement, award, or implementation of a Bank-financed contract is dealt with in accordance with the provisions of the Bank’s Policy on Prohibited Practices. Suppliers, contractors, service providers and consultants selected pursuant to the provisions of Section II and concessionaires selected pursuant to paragraph 14.3 of the Bank’s Procurement Instructions for Recipients, as well as the Recipient shall fully cooperate with the Bank (or a cofinancier undertaking an investigation

pursuant to paragraph 6.1 of the Bank's Procurement Instructions for Recipients) in any investigation into an alleged Prohibited Practice to be carried out pursuant to the Policy on Prohibited Practices, and permit the Bank or its representative (including such co-financier) to inspect such of their accounts and records as may be relevant for such investigation and to have such records and accounts audited by the auditors appointed by the Bank.

4. Provisions to this effect are included in the Legal Agreements and the procurement contracts with such entities.
5. If the Project is financed by a sovereign-backed loan, the Bank (or, where relevant, a co-financier having undertaken an investigation pursuant to paragraph 6.1 of the Bank's Procurement Instructions for Recipients):
 - (a) may take any of the following additional actions in connection with a Prohibited Practice under the Project:
 - (i) reject a proposal for award if it determines that the tenderer recommended for award, or any of its personnel, or its agents, or its sub-consultants, subcontractors, service providers, suppliers or their employees, has, directly or indirectly, engaged in a prohibited practice in competing for the contract in question; and
 - (ii) cancel the undisbursed portion of the loan allocated to a contract (and require reimbursement of the disbursed portion of the loan allocated to the contract) if it determines at any time that representatives of the Recipient or of a recipient of any part of the proceeds of the loan engaged in a prohibited practice during the procurement, administration or implementation of the contract in question; and
 - (b) requires that a clause be included in tender documents and in contracts financed by the Bank loan, requiring tenderers, suppliers and contractors, and their subcontractors, agents, personnel, consultants, service providers, or suppliers, to permit the Bank (and a co-financier undertaking an investigation pursuant to paragraph 6.1 of the Bank's Procurement Instructions for Recipients) to inspect all accounts, records, and other documents relating to the submission of tenders and contract performance, and to have them audited by auditors appointed by the Bank.

Section X - Contract Forms

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Notification of Intention to Award

[This Notification of Intention to Award shall be sent to each Tenderer that submitted a Tender.]

[Send this Notification to the Tenderer's Authorized Representative named in the Tenderer Information Form]

For the attention of Tenderer's Authorized Representative

Name: *[insert Authorized Representative's name]*

Address: *[insert Authorized Representative's Address]*

Telephone/Fax numbers: *[insert Authorized Representative's telephone/fax numbers]*

Email Address: *[insert Authorized Representative's email address]*

[IMPORTANT: insert below the date that this Notification is transmitted to Tenderers. The Notification must be sent to all Tenderers simultaneously. This means on the same date and as close to the same time as possible.]

DATE OF TRANSMISSION: This Notification is sent by: *[email/fax]* on *[date]* (local time)

Notification of Intention to Award

Employer: *[insert the name of the Employer]*

Project: *[insert name of project]*

Country: *[insert country where Tender is issued]*

Loan No.: *[insert reference number for loan]*

Tender No.: *[insert Tender reference number from Procurement Plan]*

Contract Title: *[insert the name of the contract]*

This Notification of Intention to Award (Notification) notifies you of our decision to award the above contract. The transmission of this Notification begins the Standstill Period. During the Standstill Period you may:

- a) request a debriefing in relation to the evaluation of your Tender, and/or
- b) submit a Procurement-related Complaint in relation to the decision to award the contract.

1. The successful Tenderer

Name:	<i>[insert name of successful Tenderer]</i>
Address:	<i>[insert address of the successful Tenderer]</i>
Contract Price:	<i>[insert contract price of the successful Tender]</i>

2. List of all Tenderers **[INSTRUCTIONS: insert names of all Tenderers that submitted a Tender including the successful Tenderer, together with the corresponding Tender price]**

as read out at tender opening and the evaluated Tender price (when rated criteria are not used).]

Name of Tenderer	Tender Price	Evaluated Tender Price (if applicable)
[insert name]	[insert Tender price]	[insert evaluated price]
[insert name]	[insert Tender price]	[insert evaluated price]
[insert name]	[insert Tender price]	[insert evaluated price]
[insert name]	[insert Tender price]	[insert evaluated price]
[insert name]	[insert Tender price]	[insert evaluated price]

Or

List of all Tenderers *[INSTRUCTIONS: insert names of all Tenderers that submitted a Tender including the successful Tenderer, together with the corresponding Tender price as read out at tender opening and the evaluated Tender price, respective technical and financial scores, combined technical and financial score (when rated criteria are used).]*

Name of Tenderer	Tender Price	Evaluated Tender Price	Technical Score	Financial Score	Combined Score
[insert name]	[insert Tender price]	[insert evaluated price]			
[insert name]	[insert Tender price]	[insert evaluated price]			
[insert name]	[insert Tender price]	[insert evaluated price]			
[insert name]	[insert Tender price]	[insert evaluated price]			
[insert name]	[insert Tender price]	[insert evaluated price]			

3. Reason/s why your Tender was unsuccessful

[INSTRUCTIONS: State the reason/s why this Tenderer's Tender was unsuccessful. Do NOT include: (a) a point by point comparison with another Tenderer's Tender, or (b) information that is marked confidential by the Tenderer in its Tender.]

4. How to request a debriefing

DEADLINE: The deadline to request a debriefing expires at midnight on [insert date] (local time).

You may request a debriefing in relation to the results of the evaluation of your Tender. If you decide to request a debriefing your written request must be made within three (3) Business Days of receipt of this Notification of Intention to Award.

Provide the contract name, reference number, name of the Tenderer, contact details; and address the request for debriefing as follows:

Attention: [insert full name of person, if applicable]

Title/position: [insert title/position]

Agency: [insert name of Employer]

Email address: [insert email address]

Fax number: [insert fax number] *delete if not used*

If your request for a debriefing is received within the 3 Business Days deadline, we will provide the debriefing within five (5) Business Days of receipt of your request. If we are unable to provide the debriefing within this period, the Standstill Period shall be extended by five (5) Business Days after the date that the debriefing is provided. If this happens, we will notify you and confirm the date that the extended Standstill Period will end.

The debriefing may be in writing, by phone, video conference call or in person. We shall promptly advise you in writing how the debriefing will take place and confirm the date and time.

If the deadline to request a debriefing has expired, you may still request a debriefing. In this case, we will provide the debriefing as soon as practicable, and normally no later than fifteen (15) Business Days from the date of publication of the Contract Award Notice.

5. How to make a complaint

Period: Procurement-related Complaint challenging the decision to award shall be submitted by midnight, [insert date] (local time).

Provide the contract name, reference number, name of the Tenderer, contact details; and address the Procurement-related Complaint as follows:

Attention: [insert full name of person, if applicable]

Title/position: [insert title/position]

Agency: [insert name of Employer]

Email address: [insert email address]

Fax number: [insert fax number] *delete if not used*

At this point in the procurement process, you may submit a Procurement-related Complaint challenging the decision to award the contract. You do not need to have requested, or received, a debriefing before making this complaint. Your complaint must be submitted within the Standstill Period and received by us before the Standstill Period ends.

For more information see the [Procurement Instructions for Recipients](#) (Annex IV, Complaint Monitoring).

6. Standstill Period

DEADLINE: The Standstill Period is due to end at midnight on [insert date] (local time).

The Standstill Period lasts ten (10) Business Days after the date of transmission of this Notification of Intention to Award.

The Standstill Period may be extended as stated in Section 4 above.

If you have any questions regarding this Notification, please do not hesitate to contact us.

For and on behalf of the Employer:

Signature: _____

Name: _____

Title/Position: _____

Telephone: _____

Email: _____

Beneficial Ownership Disclosure Form

INSTRUCTIONS TO TENDERERS: DELETE THIS BOX ONCE YOU HAVE COMPLETED THE FORM

This Beneficial Ownership Disclosure Form (“Form”) is to be completed by the successful Tenderer. In case of joint venture, the Tenderer must submit a separate Form for each member. The beneficial ownership information to be submitted in this Form shall be current as of the date of its submission.

For the purposes of this Form, a Beneficial Owner of a Tenderer is any natural person who ultimately owns or controls the Tenderer by meeting one or more of the following conditions:

- *directly or indirectly holding 25% or more of the shares*
- *directly or indirectly holding 25% or more of the voting rights*
- *directly or indirectly having the right to appoint a majority of the board of directors or equivalent governing body of the Tenderer*

Tender No.: *[insert number of Tender process]*

To: **Haryana Rail Infrastructure Development Corporation Limited**

In response to your request in the Letter of Acceptance dated *[insert date of letter of Acceptance]* to furnish additional information on beneficial ownership: *[select one option as applicable and delete the options that are not applicable]*

(i) we hereby provide the following beneficial ownership information.

Details of beneficial ownership

Identity of Beneficial Owner	Directly or indirectly holding 25% or more of the shares (Yes / No)	Directly or indirectly holding 25 % or more of the Voting Rights (Yes / No)	Directly or indirectly having the right to appoint a majority of the board of the directors or an equivalent governing body of the Tenderer (Yes / No)
<i>[include full name (last, middle, first),</i>			

<i>nationality, country of residence]</i>			
---	--	--	--

OR

(ii) *We declare that there is no Beneficial Owner meeting one or more of the following conditions:*

- directly or indirectly holding 25% or more of the shares
- directly or indirectly holding 25% or more of the voting rights
- directly or indirectly having the right to appoint a majority of the board of directors or equivalent governing body of the Tenderer

OR

(iii) *We declare that we are unable to identify any Beneficial Owner meeting one or more of the following conditions. [If this option is selected, the Tenderer shall provide explanation on why it is unable to identify any Beneficial Owner]*

- directly or indirectly holding 25% or more of the shares
- directly or indirectly holding 25% or more of the voting rights
- directly or indirectly having the right to appoint a majority of the board of directors or equivalent governing body of the Tenderer”

Name of the Tenderer: **[insert complete name of the Tenderer]* _____

Name of the person duly authorized to sign the Tender on behalf of the Tenderer: ***[insert complete name of person duly authorized to sign the Tender]* _____

Title of the person signing the Tender: *[insert complete title of the person signing the Tender]*

Signature of the person named above: *[insert signature of person whose name and capacity are shown above]* _____

Date signed *[insert date of signing]* day of *[insert month]*, *[insert year]* _____

* In the case of the Tender submitted by a Joint Venture specify the name of the Joint Venture as Tenderer. In the event that the Tenderer is a joint venture, each reference to “Tenderer” in the Beneficial Ownership Disclosure Form (including this Introduction thereto) shall be read to refer to the joint venture member.

** Person signing the Tender shall have the power of attorney given by the Tenderer. The power of attorney shall be attached with the Tender Schedules.

Letter of Acceptance

[letterhead paper of the Employer]

[date]

To: *[name and address of the Contractor]*

This is to notify you that your Tender dated *[date]* for execution of the “**Contract Package SYS-1 Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km (-)2.14 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 320 TKM).**” for the Accepted Contract Amount *[amount in numbers and words]* *[name of currency]*, as corrected and modified in accordance with the Instructions to Tenderers, is hereby accepted by our Agency.

You are requested to furnish (i) the Performance Security within 28 days in accordance with the Conditions of Contract, using, for that purpose, the Performance Security Form; and (ii) the additional information on beneficial ownership in accordance with TDS ITT 48.1, within eight (8) Business days using the Beneficial Ownership Disclosure Form, included in Section X, Contract Forms, of the Tender Document.

Authorized Signature: _____

Name and Title of Signatory: _____

Name of Agency: _____

Attachment: Contract Agreement

Contract Agreement

THIS AGREEMENT made the _____ day of _____, _____, between _____ of _____ [insert complete name of Employer and full business address] (hereinafter “the Employer”), of the one part, and _____ of _____ [insert complete name and nationality of Contractor as well as full business address] (hereinafter “the Contractor”), of the other part:

WHEREAS the Employer invited tenders for the execution of the Works, described as “**Contract Package SYS-1: Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km (-)2.14 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 320 TKM)..**”

The Employer and the Contractor agree as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Contract documents referred to.
2. The following documents shall be deemed to form and be read and construed as part of this Agreement. This Agreement shall prevail over all other Contract documents.
 - (a) the Letter of Acceptance;
 - (b) the Letter of Tender;-Financial Part;
 - (c) the Letter of Tender-Technical Part;
 - (d) the Record of Meeting on Contract Negotiation (if any);
 - (e) Beneficial Ownership Declaration Form;
 - (f) the addenda/Corrigenda Nos _____ (if any);
 - (g) the Particular Conditions of Contract;
 - (h) the General Conditions of Contract;
 - (i) the Employer’s Requirements;
 - (j) the Drawings;

- (k) the Contractor’s Technical Proposal;
 - (l) the Reference Information/Reports, and
 - (m) the completed Schedules and any other documents forming part of the contract, including, but not limited to:
 - i. the ESHS Management Strategies and Implementation Plans; and
 - ii. Code of Conduct (ESHS).
3. In consideration of the payments to be made by the Employer to the Contractor as specified in this Agreement, the Contractor hereby covenants with the Employer to execute the Works and to remedy defects therein in conformity in all respects with the provisions of the Contract.
4. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

IN WITNESS whereof the parties hereto have caused this Agreement to be executed in accordance with the laws of _____ [*insert the name of the Contract governing law country*] on the day, month and year specified above.

For and on behalf of the Employer

Signed: [*insert signature*]

in the capacity of [*insert title or other appropriate designation*]

In the presence of [*insert identification of official witness*]

For and on behalf of the Contractor

Signed: [*insert signature of authorized representative(s) of the Contractor*]

in the capacity of [*insert title or other appropriate designation*]

in the presence of [*insert identification of official witness*]

Performance Security

Demand Guarantee

[Guarantor letterhead or SWIFT identifier code]

Beneficiary:

Haryana Orbital Rail Corporation Limited ,
Plot No 143, 5th Floor, Railtel Tower,
Sector-44, Gurugram,
Haryana-122003

Date: _____ *[Insert date of issue]*

PERFORMANCE GUARANTEE No.: _____

Guarantor: *[Insert name and address of place of issue, unless indicated in the letterhead]*

We have been informed that _____ (hereinafter called "the Applicant") has entered into Contract No. HORC/HRIDC/SYS-1/2023 and LOA No.: _____ dated _____ with the Beneficiary, for the execution of **"Contract Package SYS-1: Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km (-)2.14 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 320 TKM)."**

Furthermore, we understand that, according to the conditions of the Contract, a performance guarantee is required.

At the request of the Applicant, we as Guarantor, hereby irrevocably undertake to pay the Beneficiary any sum or sums not exceeding in total an amount of _____ (),¹ such sum being payable in the types and proportions of currencies in which the Contract Price is payable, upon receipt by us of the Beneficiary's complying demand supported by the Beneficiary's statement,

¹ The Guarantor shall insert an amount representing the percentage of the Accepted Contract Amount specified in the Letter of Acceptance, less provisional sums, if any, and denominated either in the currency(cies) of the Contract or a freely convertible currency acceptable to the Beneficiary.

whether in the demand itself or in a separate signed document accompanying or identifying the demand, stating that the Applicant is in breach of its obligation(s) under the Contract, without the Beneficiary needing to prove or to show grounds for your demand or the sum specified therein.

This guarantee shall expire, no later than the Day of, 2...², and any demand for payment under it must be received by us at this office indicated above on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG) 2010 Revision, ICC Publication No. 758, except that the supporting statement under Article 15(a) is hereby excluded.

[signature(s)]

Note: All italicized text (including footnotes) is for use in preparing this form and shall be deleted from the final product.

² *Insert the date twenty-eight days after the expected completion date as described in GC Clause 11.9. The Employer should note that in the event of an extension of this date for completion of the Contract, the Employer would need to request an extension of this guarantee from the Guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee. In preparing this guarantee, the Employer might consider adding the following text to the form, at the end of the penultimate paragraph: “The Guarantor agrees to a one-time extension of this guarantee for a period not to exceed [six months][one year], in response to the Beneficiary’s written request for such extension, such request to be presented to the Guarantor before the expiry of the guarantee.”*

Advance Payment Security

Demand Guarantee

[Guarantor letterhead or SWIFT identifier code]

[Guarantor letterhead or SWIFT identifier code]

Beneficiary:

Haryana Orbital Rail Corporation Limited,
Plot No 143, 5th Floor, Railtel Tower,
Sector-44, Gurugram,
Haryana-122003

Date: _____ *[Insert date of issue]*

ADVANCE PAYMENT GUARANTEE No.: _____ *[Insert guarantee reference number]*

Guarantor: *[Insert name and address of place of issue, unless indicated in the letterhead]*

We have been informed that _____ (hereinafter called “the Applicant”) has entered into Contract No. _____ dated _____ with the Beneficiary, for the execution of “**Contract Package SYS-1: Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km (-)2.14 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 320 TKM).**”.

Furthermore, we understand that, according to the conditions of the Contract, an advance payment in the sum _____ () is to be made against an advance payment guarantee.

At the request of the Applicant, we as Guarantor, hereby irrevocably undertake to pay the Beneficiary any sum or sums not exceeding in total an amount of _____ ()¹ upon receipt

¹ *The Guarantor shall insert an amount representing the amount of the advance payment and denominated either in the currency(ies) of the advance payment as specified in the Contract, or in a freely convertible currency acceptable to the Employer.*

by us of the Beneficiary’s complying demand supported by the Beneficiary’s statement, whether in the demand itself or in a separate signed document accompanying or identifying the demand, stating either that the Applicant:

- (a) has used the advance payment for purposes other than the costs of mobilization in respect of the Works; or
- (b) has failed to repay the advance payment in accordance with the Contract conditions, specifying the amount which the Applicant has failed to repay.

A demand under this guarantee may be presented as from the presentation to the Guarantor of a certificate from the Beneficiary’s bank stating that the advance payment referred to above has been credited to the Applicant on its account number _____ at _____..

The maximum amount of this guarantee shall be progressively reduced by the amount of the advance payment repaid by the Applicant as specified in copies of interim statements or payment certificates which shall be presented to us. This guarantee shall expire, at the latest, upon our receipt of a copy of the interim payment certificate indicating that ninety (90) percent of the Accepted Contract Amount, less provisional sums, has been certified for payment, or on the ___ day of ____, 2___,² whichever is earlier. Consequently, any demand for payment under this guarantee must be received by us at this office on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG) 2010 Revision, ICC Publication No. 758, except that the supporting statement under Article 15(a) is hereby excluded.

[signature(s)]

Note: All italicized text (including footnotes) is for use in preparing this form and shall be deleted from the final product.

² *Insert the expected expiration date of the Time for Completion. The Employer should note that in the event of an extension of the time for completion of the Contract, the Employer would need to request an extension of this guarantee from the Guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee. In preparing this guarantee, the Employer might consider adding the following text to the form, at the end of the penultimate paragraph: “The Guarantor agrees to a one-time extension of this guarantee for a period not to exceed [six months][one year], in response to the Beneficiary’s written request for such extension, such request to be presented to the Guarantor before the expiry of the guarantee.”*

Retention Money Security

Demand Guarantee

_____ [Guarantor letterhead or SWIFT identifier code]

Beneficiary:

Haryana Orbital Rail Corporation Limited,
Plot No 143, 5th Floor, Railtel Tower,
Sector-44, Gurugram,
Haryana-122003

Date: _____ [Insert date of issue]

RETENTION MONEY GUARANTEE No.: _____ [Insert guarantee reference number]

Guarantor: [Insert name and address of place of issue, unless indicated in the letterhead]

We have been informed that _____ [insert name of Contractor, which in the case of a joint venture shall be the name of the joint venture] (hereinafter called "the Applicant") has entered into Contract No. _____ [insert reference number of the contract] dated _____ with the Beneficiary, for the execution of **“Contract Package SYS-1: Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km (-)2.14 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 320 TKM).**

Furthermore, we understand that, according to the conditions of the Contract, the Beneficiary retains moneys up to the limit set forth in the Contract (“the Retention Money”), and that when the Taking-Over Certificate has been issued under the Contract and the first half of the Retention Money has been certified for payment, payment of [insert the second half of the Retention Money or if the amount guaranteed under the Performance Guarantee when the Taking-Over Certificate is issued is less than half of the Retention Money, the difference between half of the Retention

Money and the amount guaranteed under the Performance Security is to be made against a Retention Money guarantee.

At the request of the Applicant, we, as Guarantor, hereby irrevocably undertake to pay the Beneficiary any sum or sums not exceeding in total an amount of _____ [insert amount in figures]()[amount in words]¹ upon receipt by us of the Beneficiary’s complying demand supported by the Beneficiary’s statement, whether in the demand itself or in a separate signed document accompanying or identifying the demand, stating that the Applicant is in breach of its obligation(s) under the Contract, without your needing to prove or show grounds for your demand or the sum specified therein.

A demand under this guarantee may be presented as from the presentation to the Guarantor of a certificate from the Beneficiary’s bank stating that the second half of the Retention Money as referred to above has been credited to the Applicant on its account number _____ at _____ [insert name and address of Applicant’s bank].

This guarantee shall expire no later than the Day of, 2...², and any demand for payment under it must be received by us at the office indicated above on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG) 2010 Revision, ICC Publication No. 758, except that the supporting statement under Article 15(a) is hereby excluded.

[signature(s)]

Note: All italicized text (including footnotes) is for use in preparing this form and shall be deleted from the final product.

¹ The Guarantor shall insert an amount representing the amount of the second half of the Retention Money or if the amount guaranteed under the Performance Guarantee when the Taking-Over Certificate is issued is less than half of the Retention Money, the difference between half of the Retention Money and the amount guaranteed under the Performance Security and denominated either in the currency(ies) of the second half of the Retention Money as specified in the Contract, or in a freely convertible currency acceptable to the Beneficiary.

² Insert the same expiry date as set forth in the performance security, representing the date twenty-eight days after the completion date described in GCC Clause 11.9. The Employer should note that in the event of an extension of this date for completion of the Contract, the Employer would need to request an extension of this guarantee from the Guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee. In preparing this guarantee, the Employer might consider adding the following text to the form, at the end of the penultimate paragraph: “The Guarantor agrees to a one-time extension of this guarantee for a period not to exceed [six months][one year], in response to the Beneficiary’s written request for such extension, such request to be presented to the Guarantor before the expiry of the guarantee.”

Contractor’s Warranty

This Agreement is made on the day of between

- (1) [] of [] [and [see Note 1]] ([jointly] “the Contractor”).
- (2) the Haryana Orbital Rail Corporation Limited [of/[whose registered office is at] [XXX] Limited, together with its successors and assigns, “the Employer”) _____,

WHEREAS

(A) By a contract [_____] dated [_____] (“the Contract”) made between

(1) the Haryana Orbital Rail Corporation Limited (“the Employer”) and

(2) [(“the Contractor”) has agreed to design, execute, complete, test and commission (including Integrated Testing and Commissioning) and remedy any defects in the works (“the Works”) upon the terms and conditions contained in the Contract.

(B) [See Note 3]

(C) At the request of the Employer and pursuant to the terms of the Contract the Contractor has agreed to enter into this Warranty.

NOW IT IS AGREED as follows:

1. The Contractor hereby warrants and undertakes that:

- (a) he will design, execute, complete, test and commission (including Integrated Testing and Commissioning) and remedy any defect in the Works in accordance with the terms of the Contract; and;
- (b) he owes a duty of care to the Employer in relation to the performance of its duties under the Contract; and
- (c) he will replace free of cost to the Employer any defect or failure of equipment /material/services provided in the Works for the duration of Defect Notification Period as per the Contract; and
- (d) he agrees that should any design modification be required to any equipment or component as a consequence of failure analysis, for the duration of Defect Notification Period as per the Contract, shall recommence from the date when the modified part is commissioned into service, and such modification shall be carried out free of cost to the Employer in all sub-systems and systems for all sections; and
- (e) he shall maintain the manufacture or spare of replacement parts for at least 10 years.

2. The liability of [the companies comprising [see Note 3]] the Contractor under this Warranty [shall be joint and several and [see Note 3]] shall not be released, diminished or in any way affected by any independent inquiry or investigation into the Works or any matter related

to the Contract whether carried out by or on behalf of the Employer or any liability or right of action which may arise out of such inquiry or investigation.

3. Insofar as the copyright or other intellectual property rights in any plans, calculations, drawings, documents, materials, plant, know-how and other information relating to the Works shall be vested in the Contractor, the Contractor grants to the Employer his successors and assigns a royalty free, non-exclusive and irrevocable licence (carrying the right to grant sub-licences) to use and reproduce any of the works designs or inventions incorporated and referred to in such documents or materials and any such know-how and information for all purposes relating to the Works or the Project including without limitation the design, manufacture, supply, installation, testing and commissioning (including Integrated Testing and Commissioning) reinstatement, extension and the remedy of any defect in the Works. To the extent that beneficial ownership of any such copyright or other intellectual property rights is vested in anyone other than the Contractor, the Contractor shall use best endeavours to procure that the beneficial owner thereof shall grant a like licence to the Employer. For the avoidance of doubt, any such licence granted shall not be determined if the Contractor shall for any reason cease to be employed in connection with the Works.
4. The provisions of this Warranty shall be without prejudice to and shall not be deemed or construed so as to limit or exclude any rights or remedies which the Employer may have against the Contractor, whether in tort or otherwise.
5. Nothing contained in this Warranty shall vary or affect the Contractor's rights and obligations under the Contract.
6. The address for service of all documents arising out of or in connection with this Warranty shall be:
 - (a) upon the Employer, at [_____] India [Note 4];
 - (b) upon the Contractor, at [_____] India [Note 4].
7. The Employer and the Contractor may change their respective nominated addresses for service of documents to another address in India but only by prior written notice to each other. All notices must be in writing.
8. This Warranty shall be governed by and construed according to the laws for the time being in force in India.
9.
 - (1) Any dispute or difference of any kind whatsoever between the Employer and the Contractor arising under out of or in connection with this Warranty shall be referred to arbitration in accordance with the Conciliation and Arbitration rules set out in the General Conditions of Contract. "Dispute" as defined in the Contract shall be deemed to include any such dispute or difference between the Employer and Contractor.
 - (2) In the event that the Employer is of the opinion that the issues in such a dispute or difference will or may touch upon or concern a dispute or difference arising under out of or in connection with the Contract ("the Contract Dispute") then provided that an arbitrator has not already been appointed pursuant to Clause 9(1), the Employer may by notice in writing to the Contractor require and the Contractor shall be deemed to

have consented to the referral of such dispute or difference to the arbitrator to whom the Contract Dispute has been or will be referred.

- (3) Save as expressly otherwise provided, the arbitrator shall have full power to open up, review and revise any decision, opinion, instruction, notice, order, direction, withholding of approval or consent, determination, certificate, statement of objections relating to the dispute.
- (4) Subject to the foregoing provisions of this Clause 9, the Employer and the Contractor agree to submit to the jurisdiction of the Courts of India at Gurugram, Haryana.

IN WITNESS where of this Warranty has been executed as a deed on the date written at the head hereof.

THE COMMON SEAL of)

[_____])

was affixed hereto)

in the presence of:)

Notes: (for preparation of but not for inclusion in the engrossment of this Warranty)

- (1) If the Contractor comprises more than one company, each such company shall be a party and liability under this warranty will be joint and several, with consequential grammatical changes.
- (2) If Note 1 applies, that fact and the joint venture or other relevant agreement must be recited.
- (3) Delete if Note 1 does not apply.
- (4) The address for service shall be in India.

FINANCIAL PART (PDF FILE)

**To be signed and uploaded with BOQ (MS Excel File)
as FINANCIAL PART of the Tender by the Tenderer.**

Letter of Tender – Financial Part

INSTRUCTIONS TO TENDERERS: DELETE THIS BOX ONCE YOU HAVE COMPLETED THE DOCUMENT

The Tenderer must prepare this Letter of Tender on stationery with its letterhead clearly showing the Tenderer's complete name and business address.

Note: All italicized text is to help Tenderers in preparing this form.

Date of this Tender submission: *[insert date (as day, month and year) of Tender submission]*

Tender No.: HORC/HRIDC/SYS-1/2023

To:

GM/IE&A,

Haryana Rail Infrastructure Development Corporation Limited (HRIDC),

Plot no.143, 5th floor,

Railtel Tower, Sector-44

Gurugram – 122003

Tel: +91 8860124749

We, the undersigned, hereby submit the second part of our Tender, the Tender Price and Price Schedule. This accompanies the Letter of Tender – Technical Part.

In submitting our Tender, we declare that:

- (a) **Tender Validity Period:** Our Tender shall be valid for the period specified in TDS 18.1 (as amended, if applicable) after the date fixed for the Tender submission deadline specified in TDS 22.1 (as amended, if applicable), and it shall remain binding upon us and may be accepted at any time before the expiration of that period;
- (b) ****Tender Price:** The total price of our Tender including Provisional Sum is: *[insert the total price of the Tender in words and figures in INR];*
- (c) **Commissions, Gratuities, Fees:** We have paid, or will pay the following commissions, gratuities, or fees with respect to the Tendering process or execution of the Contract: *[insert complete name of each Recipient, its full address, the reason for which each commission or gratuity was paid and the amount and currency of each such commission or gratuity]*

Name of Recipient	Address	Reason	Amount

(If none has been paid or is to be paid, indicate “none.”)

Name of the Tenderer: *[insert complete name of the Tenderer]*

Name of the person duly authorized to sign the Tender on behalf of the Tenderer: **[insert complete name of person duly authorized to sign the Tender]*

Title of the person signing the Tender: *[insert complete title of the person signing the Tender]*

Signature of the person named above: *[insert signature of person whose name and capacity are shown above]*

Date signed *[insert date of signing]* **day of** *[insert month]*, *[insert year]*

*: Person signing the Tender shall have the power of attorney given by the Tenderer. The power of attorney shall be attached with the Letter of Tender.

** The total price of Tender including Provisional Sums quoted in this Letter of Tender-Financial Part shall be same as given in Worksheet BOQ3 (Price Schedule –Summary Sheet) of MS-Excel File which includes cost of Schedule ‘A’ plus Schedule ‘B’ and plus Provisional Sum.

Appendix A to Financial Part: Schedule of Adjustment Data

1. Price adjustment

- 1.1 The amounts payable to the Contractor for Works shall be adjusted in accordance with the provisions of this Clause 1.0, Sub-Clause 13.7 of GCC and Sub-Clause 13.7, Specific Provision, Part B, Section IX-PCC.
- 1.2 The Contract Price shall be adjusted for increase or decrease in rates and prices of labour, materials, Electrical equipment and other commodities or inputs in accordance with the principles, procedures and formulae specified below:
- a) Base month for the purpose of Price Adjustment shall be the month in which the Tender is opened. The 1st Quarter will start from Base month;
 - b) For Schedule-A, Price adjustment shall be applied on completion of the specified stage of the respective item of work.

The following expressions and meanings are assigned to the Cost Centre of Price Schedule ‘A’:

Cost Centre	Description of Cost Centre	Price Adjustment
1	2	3
E1	Surveys, Investigation, Studies, Design and Documents, O & M Manuals, As Built Drawings and Training of staffs	Not Applicable
E2	OHE Works	Applicable
E3	Traction Substations (TSS)	Applicable
E4	Sectioning Post (SP)	Applicable
E5	Sub Sectioning Post (SSP)	Applicable
E6	SCADA	Applicable
E7	Spares and Tools	Applicable only for Sub Cost Centre E7.1 & E7.2
E8	Annual Maintenance contract for 3 Years	Not Applicable

- c) **The following expressions and meanings are assigned to the value of the work done for electrification works under Price Schedule ‘A’:**
- i) OHE = Value of work done for the completion of a stage under cost Centre ‘E2- Overhead Equipment Work’ of Price Schedule ‘A’;
 - ii) TSS = Value of work done for the completion of a stage under cost Centre ‘E3- Traction Sub-Station’ of Price Schedule ‘A’;
 - iii) SP = Value of work done for the completion of a stage under cost Centre ‘E4 - Sectioning Posts (SP)’ of Price Schedule ‘A’;
 - iv) SSP = Value of work done for the completion of a stage under cost Centre ‘E5 - Sub Sectioning Posts (SSP)’ of Price Schedule ‘A’;

- v) SCADA = Value of work done for the completion of a stage under cost Centre ‘E6-SCADA’ of Price Schedule ‘A’;
- vi) SPARES = Value of work done for the completion of a stage under Sub Cost Centre ‘E7.1-Supply of spares for OHE works’ & ‘E7.2-Supply of spares for Traction Power Installation’ of Price Schedule ‘A’;
- d) Price adjustment for changes in cost for electrification works under Price Schedule ‘A’ shall be paid in accordance with the following formula:**
- i) **VOHE** = $0.85 \text{ OHE} \times [\text{PLB} \times (\text{LBi} - \text{LBo})/\text{LBo} + \text{PC} \times (\text{Ci} - \text{Co})/\text{Co} + \text{PSST} \times (\text{SSTi} - \text{SSTo})/\text{SSTo} + \text{PCU} \times (\text{CUi} - \text{CUo})/\text{CUo} + \text{PINS} \times (\text{INSi} - \text{INSo})/\text{INSo}] + \text{PSWGR} \times (\text{SWGRi} - \text{SWGRo})/\text{SWGRo}; + \text{POTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}$
- ii) **VTSS** = $0.85 \text{ TSS} \times [\text{PLB} \times (\text{LBi} - \text{LBo})/\text{LBo} + \text{PTR} \times (\text{TRi} - \text{TRo})/\text{TRo} + \text{PC} \times (\text{Ci} - \text{Co})/\text{Co} + \text{PSST} \times (\text{SSTi} - \text{SSTo})/\text{SSTo} + \text{PSWGR} \times (\text{SWGRi} - \text{SWGRo})/\text{SWGRo} + \text{POTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}];$
- iii) **VSP** = $0.85 \text{ SP} \times [\text{PLB} \times (\text{LBi} - \text{LBo})/\text{LBo} + \text{PC} \times (\text{Ci} - \text{Co})/\text{Co} + \text{PSWGR} \times (\text{SWGRi} - \text{SWGRo})/\text{SWGRo} + \text{PSST} \times (\text{SSTi} - \text{SSTo})/\text{SSTo}] + \text{POTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}$
- iv) **VSSP** = $0.85 \text{ SP} \times [\text{PLB} \times (\text{LBi} - \text{LBo})/\text{LBo} + \text{PC} \times (\text{Ci} - \text{Co})/\text{Co} + \text{PSWGR} \times (\text{SWGRi} - \text{SWGRo})/\text{SWGRo} + \text{PSST} \times (\text{SSTi} - \text{SSTo})/\text{SSTo} + \text{POTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}]$
- v) **VSCADA** = $0.85 \text{ SCADA} \times [\text{PLB} \times (\text{LBi} - \text{LBo})/\text{LBo} + \text{PELEX} \times (\text{ELEXi} - \text{ELEXo})/\text{ELEXo} + \text{POTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}];$
- vi) **VSPARE** = $0.85 \text{ SPARE} \times \text{PSST} \times (\text{SSTi} - \text{SSTo})/\text{SSTo} + \text{PCU} \times (\text{CUi} - \text{CUo})/\text{CUo} + \text{PINS} \times (\text{INSi} - \text{INSo})/\text{INSo}] + \text{PSWGR} \times (\text{SWGRi} - \text{SWGRo})/\text{SWGRo}; + \text{PTR} \times (\text{TRi} - \text{TRo})/\text{TRo} + [\text{POTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}];$

Where:-

VOHE = Increase or decrease in the cost under cost centre ‘E2’ of Price Schedule ‘A’ of Over Head Equipment and other related works during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (e);

VTSS = Increase or decrease in the cost under cost centre ‘E3’ of Price Schedule ‘A’ of Traction Sub-Station and other related works during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (e);

VSP = Increase or decrease in the cost under cost centre ‘E4’ of Price Schedule ‘A’ of Sectioning Post (SP) and other related works during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (e);

VSSP = Increase or decrease in the cost under cost centre ‘E5’ of Price Schedule ‘A’ of Sub Sectioning Post (SSP) and other related works during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (e);

VSCADA = Increase or decrease in the cost under cost centre ‘E6’ of Price Schedule ‘A’ of SCADA and related works during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (e);

VSPARE = Increase or decrease in the cost under Sub Cost Centre ‘E7.1-Supply of spares for OHE works’ & ‘E7.2-Supply of spares for Traction Power Installation’ of Price Schedule ‘A’ during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (e);

PLB, PC, PSST, PCU, PINS, PSWGR, PTR, PELEX, and POTH are the percentages of Labour, Cement, Structural Steel, Copper Wire, Insulators, Electrical Switch Gears, Transformer, Electronic Items and All Other Commodities respectively for the relevant item as specified in sub-paragraph (e);

LBo = The consumer price index for industrial workers – All India, published by Labour Bureau, Ministry of Labour, Government of India, (hereinafter called “CPI”) for the Base month;

LBi = The CPI for industrial workers – All India for the average price index of the 3 months of the quarter under consideration

Co = The wholesale Price Index as published by the Ministry of Commerce & Industry, Government of India (hereinafter called “WPI”) for cement, lime, plaster for the Base month;

Ci = The WPI for cement, lime, plaster for the average price index of the 3 months of the quarter under consideration.

SSTo= Price of BLOOMS –Retail (SBLR) 150mmx150mm published by IEEMA for the Base month;

SSTi = = Price of BLOOMS –Retail (SBLR) 150mmx150mm published by IEEMA for the average price index of the 3 months of the quarter under consideration;

CUo= Copper: (CU) Price of Copper Wire Rod published by IEEMA for the Base month;

CUi = Copper: (CU) Price of Copper Wire Rod published by IEEMA for the average price index of the 3 months of the quarter under consideration;

INSo = The WPI for insulators for the Base month;

INSi = The WPI for insulators for the average price index of the 3 months of the quarter under consideration;

SWGRo = The WPI for MANUFACTURE OF ELECTRICAL EQUIPMENT for the Base month;

SWGRi = The WPI for MANUFACTURE OF ELECTRICAL EQUIPMENT for the average price index of the 3 months of the quarter under consideration;

TRo= The WPI for transformers for the Base month;

TRi= The WPI for transformers for the average price index of the 3 months of the quarter under consideration.

ELEXo = The WPI for MANUFACTURE OF ELECTRONIC COMPONENTS electronic items for the Base month;

ELEXi = The WPI for MANUFACTURE OF ELECTRONIC COMPONENTS for the average price index of the 3 months of the quarter under consideration;

OTHo = The WPI for all commodities for the Base month;

OTHi = The WPI for all commodities for the average price index of the 3 months of the quarter under consideration;

- e) **The following percentages shall govern the price adjustment of the Contract Price for electrification works:**

Component	SCHEDULE 'A'					
	OHE (Cost Centre E2)	TSS (Cost Centre E3)	SP (Cost Centre E4)	SSP (Cost Centre E5)	SCADA (Cost Centre E6)	Spares (Sub Cost Centre E 7.1 & E 7.2)
Labour (PLB)	10%	2.3%	5.2%	6%	14%	-
Cement (PC)	10%	3%	3%	4%	-	-
Structural steel (PSST)	31%	2.5%	3.8%	5%	-	8%
Insulators (PINS)	6.5%	-	-	-	-	4%
Copper wire (PCU)	35%	-	-	-	-	12%
Transformer (PTR)	0.5%	72.5%	55%	48%	-	15%
Electrical Switch Gear (PSWGR)	-	9.5%	16%	27%	-	12%
Electronic (PELEX)	-	-	-	-	76%	-
All other commodities (POTH)	7%	11.2%	17%	14%	10%	49%
Total	100%	100%	100%	100%	100%	100%

- f) The following expressions and meanings are assigned to Sub Schedules under Price Schedule ‘B’:

Sub Schedule	Description of Sub Schedule Cost	Price Adjustment
1	2	3
B1	General	Applicable
B2	Concrete	Applicable
B3	Ferrous	Applicable
B4	Non Ferrous	Applicable
B5	Catenary & Contact wire	Applicable
B6	Insulators	Applicable
B7	SCADA at Harsana Kalan IR SSP	Applicable
B8	Non Schedule (NS) Items	Not Applicable

- g) **The following expressions and meanings are assigned to the value of the work done for electrification works under Price Schedule ‘B’:**

- i) **GEN** = Value of work done for the completion of a stage under Sub Schedule ‘B1 -General’ of Price Schedule ‘B’;
- ii) **CON** = Value of work done for the completion of a stage under Sub Schedule ‘B2 -Concrete’ of Price Schedule ‘B’;
- iii) **FER** = Value of work done for the completion of a stage under Sub Schedule ‘B3 -Ferrous’ of Price Schedule ‘B’;
- iv) **NFER** = Value of work done for the completion of a stage under Sub Schedule ‘B4 -Non-Ferrous’ of Price Schedule ‘B’;
- v) **CATCO** = Value of work done for the completion of a stage under Sub Schedule ‘B5 - Catenary and contact’ of Price Schedule ‘B’;
- vi) **INS** = Value of work done for the completion of a stage under Sub Schedule ‘B6 -Insulators’ of Price Schedule ‘B’;
- vii) **SCADA** = Value of work done for the completion of a stage under Sub Schedule ‘B7-SCADA’ of Price Schedule ‘B’;

- h) **Price adjustment for changes in cost for electrification works under Price Schedule ‘B’ shall be paid in accordance with the following formula:**

- i)
$$\mathbf{VGEN} = 0.85 \text{ GEN} \times [\text{PLB} \times (\text{LBi} - \text{LBo})/\text{LBo} + \text{PSST} \times (\text{SSTi} - \text{SSTo})/\text{SSTo} + \text{PCU} \times (\text{CUi} - \text{CUo})/\text{CUo} + \text{PSWGR} \times (\text{SWGRi} - \text{SWGRo})/\text{SWGRo}] + \text{POTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}]$$
- ii)
$$\mathbf{VCON} = 0.85 \text{ CON} \times [\text{PLB} \times (\text{LBi} - \text{LBo})/\text{LBo} + \text{PC} \times (\text{Ci} - \text{Co})/\text{Co} + \text{OTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}]$$
- iii)
$$\mathbf{VFER} = 0.85 \text{ FER} \times [\text{PLB} \times (\text{LBi} - \text{LBo})/\text{LBo} + \text{PSST} \times (\text{SSTi} - \text{SSTo})/\text{SSTo} + \text{POTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}]$$

- iv) $\mathbf{VNFER} = 0.85 \text{ NFER} \times [\text{PLB} \times (\text{LBi} - \text{LBo})/\text{LBo} + \text{PINS} \times (\text{INSi} - \text{INSo})/\text{INSo} + \text{PCU} \times (\text{CUi} - \text{CUo})/\text{CUo} + \text{PSWGR} \times (\text{SWGRi} - \text{SWGRo})/\text{SWGRo} + \text{POTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}]$
- v) $\mathbf{VCATCO} = 0.85 \text{ CATCO} \times [\text{PCU} \times (\text{CUi} - \text{CUo})/\text{CUo}] ;$
- vi) $\mathbf{VINS} = 0.85 \text{ INS} \times [\text{PINS} \times (\text{INSi} - \text{INSo})/\text{INSo}] ;$
- vii) $\mathbf{VSCADA} = 0.85 \text{ SCADA} \times [\text{PLB} \times (\text{LBi} - \text{LBo})/\text{LBo} + \text{PELEX} \times (\text{ELEXi} - \text{ELEXo})/\text{ELEXo} + \text{POTH} \times (\text{OTHi} - \text{OTHo})/\text{OTHo}] ;$

Where:-

VGEN = Increase or decrease in the cost under Sub Schedule ‘B1-General’ of Price Schedule ‘B’ during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (i);

VCON = Increase or decrease in the cost under Sub Schedule ‘B2-Concrete’ of Price Schedule ‘B’ during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (i);

VFER = Increase or decrease in the cost under Sub Schedule ‘B3-Ferrous’ of Price Schedule ‘B’ during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (i);

VNFER = Increase or decrease in the cost under Sub Schedule ‘B4-Non-Ferrous’ of Price Schedule ‘B’ during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (i);

VCATCO = Increase or decrease in the cost under Sub Schedule ‘B5-Catenary and Contact Wire’ of Price Schedule ‘B’ during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (i);

VINS = Increase or decrease in the cost under Sub Schedule ‘B6-Insulators’ of Price Schedule ‘B’ during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (i);

VSCADA = Increase or decrease in the cost under Sub Schedule ‘B7-SCADA’ of Price Schedule ‘B’ during the period under consideration due to changes in the rates for relevant components as specified in sub-paragraph (i);

PLB, PC, PSST, PCU, PINS, PSWGR, PELEX and POTH are the percentages of Labour, Cement, Structural Steel, Copper Wire, Insulators, Electrical Switch Gears, Electronic Items and All Other Commodities respectively for the relevant item as specified in sub-paragraph (i);

LBo = The consumer price index for industrial workers – All India, published by Labour Bureau, Ministry of Labour, Government of India, (hereinafter called “CPI”) for the Base month;

LBi = The CPI for industrial workers – All India for the average price index of the 3 months of the quarter under consideration

Co = The Wholesale Price Index as published by the Ministry of Commerce & Industry, Government of India (hereinafter called “WPI”) for cement, lime, plaster for the Base month;

Ci = The WPI for cement, lime, plaster for the average price index of the 3 months of the quarter under consideration.

SSTo= Price of BLOOMS –Retail (SBLR) 150mmx150mm published by IEEMA for the Base month;

SSTi = = Price of BLOOMS –Retail (SBLR) 150mmx150mm published by IEEMA for the average price index of the 3 months of the quarter under consideration;

CUo= Copper : (CU) Price of Copper Wire Rod published by IEEMA for the Base month;

CUi = Copper : (CU) Price of Copper Wire Rod published by IEEMA for the average price index of the 3 months of the quarter under consideration;

INSo = The WPI for insulators for the Base month;

INSi = The WPI for insulators for the average price index of the 3 months of the quarter under consideration;

SWGRo = The WPI for MANUFACTURE OF ELECTRICAL EQUIPMENT for the Base month;

SWGRi = The WPI for MANUFACTURE OF ELECTRICAL EQUIPMENT for the average price index of the 3 months of the quarter under consideration;

ELEXo = The WPI for MANUFACTURE OF ELECTRONIC COMPONENTS electronic items for the Base month;

ELEXi = The WPI for MANUFACTURE OF ELECTRONIC COMPONENTS for the average price index of the 3 months of the quarter under consideration;

OTHo = The WPI for all commodities for the Base month;

OTHi = The WPI for all commodities for the average price index of the 3 months of the quarter under consideration;

- i) The following percentages shall govern the price adjustment of the Contract Price for electrification works under Schedule 'B':

Component	SCHEDULE 'B'						
	General (B1)	Concrete (B2)	Ferrous (B3)	Non-Ferrous (B4)	Catenary and Contact wire (B5)	Insulators (B6)	SCADA (B7)
Labour (PLB)	23%	20%	6%	7%	0%	0%	10%
Cement (PC)	0%	70%	0%	0%	0%	0%	0%
Structural steel (PSST)	20%	0%	90%	0%	0%	0%	0%
Insulators (PINS)	0%	0%	0%	10%	0%	100%	0%
Copper wire (PCU)	20%	0%	0%	20%	100%	0%	0%
Electrical Switch Gear (PSWGR)	20%	0%	0%	50%	0%	0%	0%
Electronic (PELEX)	0%	0%	0%	0%	0%	0%	80%
All other commodities (POTH)	17%	10%	4%	13%	0%	0%	10%
Total	100%	100%	100%	100%	100%	100%	100%

Table A. Foreign Currency (FC)

Not applicable as Tenderers are required to quote rates and prices only in INR.

Table B. Summary of Payment Currencies

For [insert name of Works]

Name of Payment Currency	A	B	C	D
	Amount of Currency	Rate of Exchange (local currency per unit of foreign)	Local Currency Equivalent $C = A \times B$	Percentage of Net Tender Price (NTP) $\frac{100 \times C}{NTP}$
For Schedule 'A'				
Local currency (INR)		1.00		
Foreign Currency #1 _____				
Foreign Currency #2 _____				
Foreign Currency #3 _____				
For Schedule 'B' expressed in Local currency (INR)		1.00		
Net Tender Price				100.00
Provisional Sums Expressed in Local Currency (INR) in million	100,000,000.00	1.00	100,000,000.00	Not Applicable
TOTAL TENDER PRICE (including provisional sum)				

Note: *The Tenderer is required to propose and submit the schedules given in tables above as part of the Tender. The rates of exchange shall be the reference rate twenty-eight (28) days prior to the deadline for submission of Tenders published by the Reserve Bank of India (RBI) on its website <https://www.rbi.org.in> . In case the exchange rate of particular currency on given date is not available on RBI web site, it will be as per the web site <https://www.fbil.org.in> of Financial Benchmark India Private Limited (FBIL). In the case, where a Tenderer is required to convert a monetary amount from a currency other than those currencies for which the RBI/FBIL reference rate is not published, the INR equivalent shall be worked out using the rate of exchange as published by the central bank of the country issuing the said currency. In case the exchange rate of that currency is not directly available in INR on the website of the central bank of the country issuing the said currency then the currency will be first converted to USD as per that web site and then converted from USD to INR as Per RBI or FBIL reference rates.*

Appendix B to Financial Part: Price Schedules

I Preamble

- 1.1. The Price Schedules shall be read in conjunction with the Instructions to Tenderers, the General Conditions, the Particular Conditions and the Employer's Requirements (General Specifications, Particular Specifications, Tender Drawings, ESHS manual) and the Addenda/Corrigenda (if any).
- 1.2. **Schedule 'A'** comprises scope of work to be executed under lump sum contract as detailed in Part 2- Employers' Requirements of Tender Document. The Tenderer has to quote a single lump sum amount against Schedule 'A'. Payment to the Contractor will be made in accordance with payment stages/Milestones defined for each Cost Centre detailed in Clause 5.0 below unless otherwise specified in the Contract.
- 1.3. **Schedule 'B'** comprises of items for "PSI works for IR Connectivity at New Prithla, Sultanpur, Asaudah, New Harsana Kalan, feeder from Harsana Kalan IR SSP to New Harsana Kalan OHE. The work has to be carried out as per the description of items given in Schedule 'B' and directions of the Engineer. Cost of design and drawings of all the temporary works, temporary road diversion is deemed to be included in the rates quoted for the relevant item of Schedule 'B' unless otherwise specified in the Contract. Schedule 'B' is further divided into eight Sub-Schedules i.e. Schedule 'B1', Schedule 'B2', Schedule 'B3', Schedule 'B4', Schedule 'B5', Schedule 'B6', Schedule 'B7' and Schedule 'B8'. The Tenderer has to quote the percentage Excess (+) or Less (-) over the total Estimated amount of Schedule 'B1', Schedule 'B2', Schedule 'B3', Schedule 'B4', Schedule 'B5', Schedule 'B6', Schedule 'B7' and Schedule 'B8' (which is shown as "Estimated Rate" against each Schedule in BOQ2 of MS excel file on eProcurement portal). The payment against this Schedule 'B' will be made on the basis of quantities executed, measured and certified. Under this Schedule, the Contractor is required to carry out other electrification works, which are not covered in Schedule 'A', as per site requirements and as per the direction of the Engineer.
- 1.4. The Schedules may not generally give a full description of the works to be performed and the plant or equipment to be supplied under each item. Tenderers shall be deemed to have read the Employer's Requirements and the other sections of the Tender Documents and reviewed the Drawings to ascertain the full scope of the requirements included in each item prior to filling the rates and prices.
- 1.5. The price quoted in the Price Schedules for Schedule 'A' and Schedule 'B' are for complete and finished items of the work in all respects. The Price quoted in the Price Schedule shall, except otherwise specifically provided, shall include all design, manufacture, supply, installation, testing commissioning and include all necessary survey work, plants, tools, machinery, Contractor's equipment, labour, compliance of labour laws, supervision, materials, transportation, handling, loading & unloading, storage, sampling, inspection, testing, fuel, oil, consumables, electric power, water, all leads & lifts, dewatering, all temporary works including temporary accesses, staging, form works and false works, stacking, provision and maintenance of all temporary works area, construction of temporary store and buildings, fencing, barricading, lighting, drainage

arrangements, erection & maintenance of inspection facilities above and below ground such as brick, concrete and steel etc., reinstatement, remedy of any defects during the Defects Notification Period, safety measures for workmen and road users, preparation of design and drawings pertaining to permanent and temporary works, & temporary diversion works, traffic diversion works, mobilisation and demobilisation, establishment and overhead charges, labour camps, insurance cost for labour and works, contractor's profit, all taxes including Goods and Service Tax (GST), insurance, royalties, duties, cess, octroi, other levies and other charges together with all general risks, liabilities and obligations set out or implied in the Contract.

- 1.6. The whole cost of complying with the provisions of the Contract shall be included in the items provided in the Price Schedule, and where no items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related items of the Work.
- 1.7. To the extent acceptable to the Employer for the purpose of making payments or partial payments, valuing variations or evaluating claims, or for such other purposes as the Engineer may reasonably require, the Contractor may provide the Engineer with a breakdown of any composite or lump sum items included in the Schedules.
- 1.8. The Provisional Sums included and so designated in the Price Schedules shall be expended in whole or in part at the direction and discretion of the Engineer. The Provisional Sum shall be used to cover the Employer's share of the DAAB members' fees and expenses, in accordance with Clause 21. No prior instruction of the Engineer shall be required with respect to the work of the DAAB in accordance with Sub-Clause 13.4 of Part B-Specific Provisions - Particular Conditions of Contract. The Contractor shall submit the DAAB members' invoices and satisfactory evidence of having paid 100% of such invoices as part of the substantiation of those statements submitted under Sub-Clause 14.3. in accordance with Sub-Clauses 13.4 of the General Conditions.
- 1.9. The prices shall be quoted against Schedule 'A' and Schedule 'B' in the Price Schedule (Excel Workbook) uploaded on the eProcurement portal.
- 1.10. The prices quoted shall be comprehensive and must include for complying in all respects with the Price Schedule, Instruction to Tenderers, the General Conditions, the Particular Conditions, Employer's Requirements, Specifications and Drawings and for all matters and things necessary for the proper design, manufacture, supply, installation, testing commissioning, completion, and making good of any defect in part or of the whole of the Works.
- 1.11. No claims for additional payment shall be allowed for any error or misunderstanding by the Contractor of the work involved.

2 Variations in Price Schedule 'A' and Schedule 'B'

- 2.1 Variations in Price Schedules shall be dealt in accordance with Sub Clause 13.3 of Section VIII- General Conditions of Contract and Section IX- Particular Conditions of Contract.
- 2.2 The through Chainages mentioned in the Scope of the Works/Tender Drawings can undergo some

minor corrections, without any impact on the overall length/Scope of the Works.

3 Measurement and Payment

- 3.1 The measurement shall be made as per Price Schedules i.e. Schedule 'A', Schedule 'B' and other relevant provisions of the Contract such as Employer's Requirements and the Drawings.
- 3.2 If during execution of the Contract, it is decided by the Employer/Engineer that one or more items of Work/Milestone of a Cost Centre in a particular Price Schedule is not required to be executed, the proportionate amount against that particular Item of Work/Milestones shall not be paid. The Engineer's decision in this regard shall be final.
- 3.3 The Payment shall be made as per Clause 14 [Contract Price and Payment] of the General Conditions and Particular Conditions.
- 3.4 The Employer shall make interim payments to the Contractor in accordance with the provisions of Sub-Clause 14.6 [Issue of Interim Payment Certificates] of the General Conditions and Particular Conditions, as certified by the Engineer on the basis of the progress achieved for the items of works/stages/Milestones of the works.
- 3.5 The Contractor shall base its claim for interim payment in accordance with Sub-Clause 14.3 [Application for Interim Payment] of the General Conditions and Particular Conditions for each stage for various items of work on the basis of actual progress of work executed (i.e. Milestones achieved) till the end of the month for which the payment is claimed in relation to the Contractor's total executed quantity, supported with documents and updated programme in accordance with the Employer's Requirements.
- 3.6 The Employer may carry out necessary tests, either directly or through an independent agency, of the Works done by the Contractor for which payment has been accepted and certified by the Engineer. The payment shall depend upon the outcome of such tests.
- 3.7 Format for the Contractor's application for payment shall be agreed between the Engineer and the Contractor.
- 3.8 All necessary supplementary details to support progress claims, including all certified Request for Inspection in hard bound copy, shall be included with application for payment. Sketches, drawings, approvals, calculations, test reports etc. shall accompany an application for payment to be substantiated and certified by the Engineer and submitted to the Employer.
- 3.9 Even if no work is executed during the month, or the Contractor does not choose to issue an application for payment, a 'NIL' application shall be submitted.
- 3.10 For the purposes of payment, the Contractor shall submit to the Engineer a detailed Price Schedule indicating a further breakdown for each stage of payment contained in the Price Schedules within forty-two (42) days after the receipt of the Letter of Acceptance. Such cost breakdowns shall be subject to approval of the Engineer who shall review and evaluate with comments and/or issue approval within twenty-eight (28) days of receipt of same. The Contractor shall resubmit the cost breakdown structure corresponding to the Engineer's comments for review, if required.

3.11 The Engineer is not obliged to issue an Interim Payment Certificate until such breakdown structure of payment schedule has been submitted and accepted by the Engineer.

4 Methodology for Claiming Payment

4.1 The Contractor shall prepare his monthly application for payment in the agreed format in six hard copies and one soft copy. This shall be accompanied by supplementary details in accordance with Sub-Clause 14.3 [Application for Interim Payment Certificates] of the General Conditions. All hard copies shall bear the original signatures of the Contractor's Representative and be submitted to the Engineer.

4.2 If these are found in order, in accordance with Sub-Clause 14.6 [Issue of Interim Payment Certificates] of the General Conditions, then the Engineer shall forward three certified copies of the application along with certified supplementary details to the Employer, with his recommendation for payment; otherwise, all documents shall be returned to the Contractor for rectification and resubmission.

5 Price Schedules

5.1 Schedule "A"- Breakup of Lump Sum cost of Electrification Works under various Sub-Heads shall be as follows:

Sub-Head	Description	Percentage of the quoted lump sum cost of Schedule 'A'	No. of Cost Centre	Total Cost of each Sub-Head
1	2	3	4	5
E	Electrification Works	100	8	E= 1xLS*

*LS = Total lump sum accepted cost of Works for Schedule 'A'

5.2 Apportionment of Contract Price for payments under various Cost Centre for Sub-Head 'E'- Electrification Works

Cost Centre	Description of Cost Centre	Percentage (%) of Cost Centre 'E'	Total Cost of Cost Centre	Total Cost of Sub-Head 'E'
1	2	3	4	5
E1	Surveys, Investigation, Studies, Design and Documents, O & M Manuals, As Built Drawings and Training of staffs	3.57	E1= 0.0357x 'E'	100% of SCH 'A'
E2	OHE Works	55.87	E2=0.5587x 'E'	
E3	Traction Substations (TSS)	17.00	E3=0.17x 'E'	
E4	Sectioning Post (SP)	5.67	E4=0.0567x 'E'	
E5	Sub Sectioning Post (SSP)	5.33	E5=0.0533x 'E'	

E6	SCADA	1.05	$E6=0.0105x 'E'$	
E7	Spares and Tools	3.63	$E7=0.0363x 'E'$	
E8	Annual Maintenance contract for 3 Years	7.88	$E8= 0.0788x 'E'$	
Total		100%		

Note: Value of 'E' shall be as defined in Sub-Clause 5.1 above.

The percentage figures as filled in column (3) for the apportionment of the Contract Price for completion of the Works corresponding to the various Sub-Heads and Cost Centres are fixed and payment will be released for different Cost centre as per above percentage break-up of Contract Price.

5.2.1 Stages of Payment i.e. Milestones of Cost Centre 'E1'- Survey, Investigations, Management plans, Studies, Design & documents, O&M manual and as built drawings, training of staff

Cost Centre		Survey, Investigations, Management plans, Studies, Design & documents, O&M manual and as built drawings, training of staff		
Weightage of Cost Centre 'E1', (X)		3.57%		
Sub Cost Centre	Item of Work		Milestones	Weightage (Y) (%)
	No.	Description		
E 1.1 Surveys of entire section for OHE & ROCS Works	E1.1.1	Surveys of entire section detailing all utilities and Geo-Technical investigations for, 2x25 kV AC Traction Electrification, ROCS in Tunnel, Viaduct, Major Bridge, Transmission Lines and associated works	Surveys of entire section detailing all utilities and Geo-Technical investigations for, 2x25 kV AC Traction Electrification, ROCS in Tunnel, Viaduct, Major Bridge, Transmission Lines and associated works	2
E1.2 Preliminary design & Documents	E1.2.1	Submission and approval of Inception Report including Design manual	Submission and approval of Inception Report including Design manual	2
	E1.2.2	Submission and approval of System Requirement Specification (SRS)	Submission and approval of System Requirement Specification (SRS)	3
	E1.2.3	Submission and approval of Management Plans	Submission and approval of Management Plans	5
	E1.2.4	Traction Simulation study report	Traction Simulation study report	6
	E1.2.5	Traction power Supply system design with supportive calculations	Traction power Supply system design with supportive calculations	4
	E1.2.6	OHE Works with supportive calculations	OHE Works with supportive calculations	4
	E1.2.7	Earthing & Bonding scheme	Earthing & Bonding scheme	2
	E1.2.8	ROCS works	ROCS works	2
	E1.2.9	SCADA System	SCADA System	2

Cost Centre	Survey, Investigations, Management plans, Studies, Design & documents, O&M manual and as built drawings, training of staff			
Weightage of Cost Centre 'E1', (X)	3.57%			
Sub Cost Centre	Item of Work		Milestones	Weightage (Y) (%)
	No.	Description		
E1.3 Detailed Design & Documents	Submission and approval of Detailed Design & Documents for Electrical works including layout Plans, Design Manuals and GFC(Good for Construction Drawings) and other Construction Reference Drawings like Combined Service Drawing etc.			
	E1.3.1	OHE Works	OHE Works	15
	E1.3.2	Traction Power Supply Works	Traction Power Supply Works	25
	E1.3.3	ROCS Works	ROCS Works	4
	E1.3.4	Traction and Auxiliary SCADA works	Traction and Auxiliary SCADA works	5
E1.4 As Built Drawings	E1.4.1	Submission and approval of As-Built Drawings for Completed works	Submission and approval of As-Built Drawings for Completed works	6
E 1.5 Operation & Maintenance Manuals	E1.5.1	Submission & Approval of Operation & Maintenance Manuals	Submission & Approval of Operation & Maintenance Manuals	3
E1.6 RAMS Plan	E1.6.1	RAMS Demonstration tests, reports, Establishing FRACAS and Defect Notification stage RAMS Plan	RAMS Demonstration tests, reports, Establishing FRACAS and Defect Notification stage RAMS Plan	3
E 1.7 Miscellaneous	E1.7.1	Any other design compliance and document required to be prepared as part of the contract	Any other design compliance and document required to be prepared as part of the contract	2
E1.8 Training	E1.8.1.	Training	Training	4
E1.9 Permits and approvals	E1.9.1	Obtaining permits and approvals as required from various Statutory & Government Bodies	Obtaining permits and approvals as required from various Statutory & Government Bodies	1

Cost Centre	Survey, Investigations, Management plans, Studies, Design & documents, O&M manual and as built drawings, training of staff			
Weightage of Cost Centre 'E1', (X)	3.57%			
Sub Cost Centre	Item of Work		Milestones	Weightage (Y) (%)
	No.	Description		
			Total	100.00

Notes:

- 1 The value of each Milestones will be total lump sum accepted cost of Works for Schedule 'A' (LS) multiplied by X * Y. For example, the value of Milestone E1.1.1 will be equal to $LS * X * Y = LS * 0.0357 * 0.02$.
- 2 Adjustment to Contract Price pursuant to GCC 13.7 shall NOT be applicable to the payments of Works executed under this Cost Centre.
- 3 Payment will be made on completion of each Milestone as per weightage given in this Cost Centre.

5.2.2 Stages of Payment i.e. Milestones of Cost Centre 'E2'- OHE Works

Cost Centre		OHE Works		
Weightage of Cost Centre 'E2', (X)		55.87%		
Sub Cost Centre	Item of work		Milestone	Weightage (Y) (%)
	No	Description		
E.2.1 Contact Wire	E 2.1.1	Supply of Contact Wire	Supply of Contact Wire	15.63
E.2.2 Catenary Wire	E 2.2.1	Supply of Catenary Wire	Supply of Catenary Wire	13.43
E2.3 Feeder wire	E 2.3.1	Supply of Feeder conductor (NFW)	Supply of Feeder conductor (NFW)	1.72
E2.4 Steel Structure	E 2.4.1	Supply Galavanised steel structure, Traction Mast and Portal and SPS including Guy Rod Assembly	Supply Galavanised steel structure, Traction Mast and Portal and SPS including Guy Rod Assembly	20.46
E2.5 Cantilever Assembly	E 2.5.1	Supply of Cantilever Assembly without Insulator	Supply of Cantilever Assembly without Insulator	6.98
E2.6 Auto Tension Device	E 2.6.1	Supply of Automatic Tensioning Device (ATD) Assembly along with counter weight assembly with SS wire Rope with Guide Tube etc	Supply of Automatic Tensioning Device (ATD) Assembly along with counter weight assembly with SS wire Rope with Guide Tube etc	1.62
E2.7 Insulators	E 2.7.1	Supply of all types of Insulators	Supply of all types of Insulators	3.04
E2.8 Motorised Isolator, Control Cable & PTFE	E 2.8.1	Supply of double pole motorised Isolators and single pole motorised Isolators with control cable with Jumpers, Section Insulators & PTFE.	Supply of double pole motorised Isolators and single pole motorised Isolators with control cable with Jumpers, Section Insulators & PTFE.	2.65
E2.9 Jumper, Anticreep wire, LS wire & Termination	E 2.9.1	Supply of Anticreep wire, along Feeder & Cross Feeder wires, Large span wire, Dropper assembly, All type Jumpers with clamps, All type Termination, NFW Suspension Clamp, 25 kV	Supply of Anticreep wire, along Feeder & Cross Feeder wires, Large span wire, Dropper assembly, All type Jumpers with clamps, All type Termination, NFW Suspension Clamp, 25 kV	5.88

Cost Centre		OHE Works		
Weightage of Cost Centre 'E2', (X)		55.87%		
Sub Cost Centre	Item of work		Milestone	Weightage (Y) (%)
	No	Description		
		power Cables, LT power cable with ACO panel, Insulating sleeve.	power Cables, LT power cable with ACO panel, Insulating sleeve.	
E2.10 Auxiliary Transformers	E 2.10.1	Supply of Auxiliary Transformers	Supply of Auxiliary Transformers	0.42
E2.11 ROCS works	E 2.11.1	Supply of ROCS Conductor rails, Support Bracket, including anchor Bolts, Cantilever assembly, Transition Element and Insulator etc	Supply of ROCS Conductor rails, Support Bracket, including anchor Bolts, Cantilever assembly, Transition Element and Insulator etc	6.23
E2.12 Balance Materials	E 2.12.1	Supply of Balance Materials i.e Retro Reflective Number Plate, Caution Board, Neutral Section Board, Engine stop Board, Warning Board, Sigma Board, Sectioning Diagram Board, Safety Screen Panel, Splices, D.O Fuse assembly, Nuts & Bolts, Protective Safety screen Panels etc to complete the entire works.	Supply of Balance Materials i.e Retro Reflective Number Plate, Caution Board, Neutral Section Board, Engine stop Board, Warning Board, Sigma Board, Sectioning Diagram Board, Safety Screen Panel, Splices, D.O Fuse assembly, Nuts & Bolts, Protective Safety screen Panels etc to complete the entire works.	0.32
E2.13 Foundation	E 2.13.1	Supply and Erection of Foundation, Grouting with Muffing including Nominal reinforcement with materials.	Supply and Erection of Foundation, Grouting with Muffing including Nominal reinforcement with materials.	12.66

Cost Centre		OHE Works		
Weightage of Cost Centre 'E2', (X)		55.87%		
Sub Cost Centre	Item of work		Milestone	Weightage (Y) (%)
	No	Description		
E2.14 Erection of Steel Structure	E 2.14.1	Erection of Galvanised Steel Structure (Mast/Portal/TTC), ROCS Support Bracket with Anchor Bolt, Cantilever, Conductor rail & Transition element and Insulators etc	Erection of Galvanised Steel Structure (Mast/Portal/TTC), ROCS Support Bracket with Anchor Bolt, Cantilever, Conductor rail & Transition element and Insulators etc	2.19
E2.15 Erection of Cantilever erection	E 2.15.1	Erection of OHE Cantilever assembly along with Insulator	Erection of OHE Cantilever assembly along with Insulator	0.66
E2.16 Erection of Balance Materials	E 2.16.1	Erection of Auxiliary Transformer, PTFE, Isolator, Section Insulator, Wiring, Droppering, ATD, .Cross Feeder, Along Feeders, Terminations, Guy rod, Jumpers, Cut in Insulators, insulating sleeves, Erection of protective screen, number plate, warning boards etc	Erection of Auxiliary Transformer, PTFE, Isolator, Section Insulator, Wiring, Droppering, ATD, .Cross Feeder, Along Feeders, Terminations, Guy rod, Jumpers, Cut in Insulators, insulating sleeves, Erection of protective screen, number plate, warning boards etc	2.33
E2.17 Earthing and Bonding	E 2.17.1	Supply and Erection of AEC, BEC (If Required), Earth electrode, GI Earth Strips, Lightning Protection, Safety screen, Earth Terminations etc.	Supply and Erection of AEC, BEC (If Required), Earth electrode, GI Earth Strips, Lightning Protection, Safety screen, Earth Terminations etc.	1.82
E2.18 Testing & Commissioning	E 2.18.1	Final Adjustment, SED Checking including Tower Wagon checking/Pantograph run, Commissioning/ Energisation of OHE system, Current collection test, completion of any other residual works of OHE system and electrical signage	Final Adjustment, SED Checking including Tower Wagon checking/Pantograph run, Commissioning/ Energisation of OHE system, Current collection test, completion of any other residual works of OHE system and electrical signage	1.96

Cost Centre		OHE Works		
Weightage of Cost Centre 'E2', (X)		55.87%		
Sub Cost Centre	Item of work		Milestone	Weightage (Y) (%)
	No	Description		
		and integrated testing as required	and integrated testing as required	
Total				100.00

Notes:

- 1 The value of each Milestones will be total lump sum accepted cost of Works for Schedule 'A' (LS) multiplied by X * Y. For example, the value of Milestone E2.1.1 will be equal to $LS * X * Y = LS \times 0.5587 \times 0.1563$
- 2 Adjustment to Contract Price pursuant to GCC 13.7 shall be applicable to the payments of Works executed under this Cost Centre.
- 3 *Deleted*
- 4 Payment will be made on pro rata *basis* as per weightage(s) given in the Cost Centre.

5.2.3 Stages of Payment i.e. Milestones of Cost Centre 'E3'- Traction Sub Station (TSS)

Cost Centre		Traction Sub Station (TSS)		
Weightage of Cost Centre 'E3', (X)		17%		
Sub Cost Centre	Items of Work		Milestone	Weightage (Y) (%)
	No	Description		
E 3.1 Ferrous Item	E 3.1.1	Supply of Steel structures and Small Parts Steel (SPS)	Supply of Steel structures and Small Parts Steel (SPS)	2.42
E 3.2 Traction Transformer	E 3.2.1	Supply of Scott connected Traction Transformers	Supply of Scott connected Traction Transformers	59.57
E 3.3 Auto Transformer	E 3.3.1	Supply of Auto Transformers and 25KV/240V Auxillary Transformers.	Supply of Auto Transformers and 25KV/240V Auxillary Transformers.	12.37
E 3.4 CB, CT, PT & Isolator Motorised	E 3.4.1	Supply of Three Pole Motorized Isolator, Double Pole Isolators including motorised, Switchgears and control gears, Circuit Breaker, interrupters, CT and PT with fittings and Fasteners.	Supply of Three Pole Isolator, Double Pole Isolators including motorised, Switchgears and control gears, Circuit Breaker, interrupters, CT and PT with fittings and Fasteners.	7.68
E 3.5 Control Relays Panels	E 3.5.1	Supply of Control and Relays Panels fully assembled	Supply of Control and Relays Panels fully assembled	1.38
E 3.6 Balance Materials	E 3.6.1	Supply of all other balance material including cables, AL/CU Busbars, Earthing material, Lightning Arresters, Battery set, Battery Chargers, Insulators, ACDB & DCDB, PFC equipment and power quality control devices, drop Jumpers, Conductor busbar, Termination Assemblies, D.O fuse assembly etc.	Supply of all other balance material including cables, AL/CU Busbars, Earthing material, Lightning Arresters, Battery set, Battery Chargers, Insulators, ACDB & DCDB, PFC equipment and power quality control devices, drop Jumpers, Conductor busbar, Termination Assemblies, D.O fuse assembly etc.	6.59
E 3.7 Foundation	E 3.7.1	(a) Completion of Earthwork, Fencing, and Foundation, Baffle wall, Cable Treach & cover, Brick work and Plastering - 3.89	(a) Completion of Earthwork, Fencing, and Foundation, Baffle wall, Cable Treach & cover, Brick work and Plastering - 3.89	3.89

Cost Centre		Traction Sub Station (TSS)		
Weightage of Cost Centre 'E3', (X)		17%		
Sub Cost Centre	Items of Work		Milestone	Weightage (Y) (%)
	No	Description		
E 3.8 Erection of Ferrous Item	E 3.8.1	Erection of Steel structures and SPS	Erection of Steel structures and SPS	0.10
E 3.9 Traction Transformer	E 3.9.1	Erection of Traction Transformers with accessories	Erection of Traction Transformers with accessories	0.10
E 3.10 Erection of Auto Transformer	E 3.10.1	Erection of Auto Transformers with accessories and 25KV/240V Auxillary Transformers.	Erection of Auto Transformers with accessories and 25KV/240V Auxillary Transformers.	0.20
E 3.11 Erection of CB, CT, PT & Isolator Motorised	E 3.11.1	Erection of Circuit Breaker, interrupters, isolators, CT, PT Control relay panel, Control & monitoring Equipment .	Erection of Circuit Breaker, interrupters, isolators, CT, PT Control relay panel, Control & monitoring Equipment .	0.41
E 3.12 Control Room Building	E 3.12.1	<p>a) Construction of control room building and its E&M works i.e Building electrification, Ventilation, Access control system and switch yard lighting including trenching, oil soak pit, water recharge pit & drainage works etc. and casting of Roads inside the TSS – 1.19% and</p> <p>b) Tower wagon shed work with inspection pit and Electricals works etc - 1.74 %</p>	<p>a) Construction of control room building and its E&M works i.e Building electrification, Ventilation, Access control system and switch yard lighting including trenching, oil soak pit, water recharge pit & drainage works etc. and casting of Roads inside the TSS – 1.19% and</p> <p>b) Tower wagon shed work with inspection pit and Electricals works etc - 1.74 %</p>	2.93

Cost Centre		Traction Sub Station (TSS)		
Weightage of Cost Centre 'E3', (X)		17%		
Sub Cost Centre	Items of Work		Milestone	Weightage (Y) (%)
	No	Description		
E 3.13 Balance Materials	E 3.13.1	Erection of all other balance indoor/outdoor equipment including Bus-bars, Earth mat, Earthing & Bonding system, Buried rail, Lighting Protection system, Fire extinguisher, Power Distribution boards, Cabling, ACSR conductors, 8 SWG GI wire, All type connectors & Splices, Insulators, Battery, Battery chargers, Signage & safety equipment's etc. as required for commissioning of TSSs	Erection of all other balance indoor/outdoor equipment including Bus-bars, Earth mat, Earthing & Bonding system, Buried rail, Lighting Protection system, Fire extinguisher, Power Distribution boards, Cabling, ACSR conductors, 8 SWG GI wire, All type connectors & Splices, Insulators, Battery, Battery chargers, Signage & safety equipment's etc. as required for commissioning of TSSs	0.40
E 3.14 Testing and Commissioning	E 3.14.1	Number plates, Other facilities, EIG Sanction and Testing and Commissioning of all equipment and Energisation.	Number plates, Other facilities, EIG Sanction and Testing and Commissioning of all equipment and Energisation.	1.96
Total				100.00

Notes:

- 1 The value of each Milestones will be total lump sum accepted cost of Works for Schedule 'A' (LS) multiplied by X * Y. For example, the value of Milestone E3.1.1 will be equal to $LS * X * Y = LS * 0.17 * 0.0242$
- 2 Adjustment to Contract Price pursuant to GCC 13.7 shall be applicable to the payments of Works executed under this Cost Centre.
- 3 *Deleted*
- 4 Payment will be made on pro rata *basis* as per weightage(s) given in this Cost Centre.

5.2.4 Stages of Payment i.e. Milestones of Cost Centre 'E4'- Sectioning Post (SP)

Cost Centre		Sectioning Post (SP)		
Weightage of Cost Centre 'E4', (X)		5.67%		
Sub Cost Centre	Item of work		Milestone	Weightage (Y) (%)
	No	Description		
E 4.1 Ferrous Item	E 4.1.1	Supply of Steel structures and Small Parts Steel (SPS)	Supply of Steel structures and Small Parts Steel (SPS)	1.65
E 4.2 Auto Transformer	E 4.2.1	Supply of Auto Transformers and 25KV/240V LT Auxillary Transformers	Supply of Auto Transformers and 25KV/240V LT Auxillary Transformers	55.12
E 4.3 CB, CT, PT & Isolator	E 4.3.1	Supply of Circuit Breaker, interrupters, CT, PT and isolators.	Supply of Circuit Breaker, interrupters, CT, PT and isolators.	10.63
E 4.4 Control Relays Panels	E 4.4.1	Supply of Control and Relays Panel with protective relays and Fault locator Panel.	Supply of Control and Relays Panel with protective relays and Fault locator Panel.	6.10
E 4.5 Balance Materials	E 4.5.1	Supply of all other balance material including cables, AL/CU Busbars, Earthing material, Buried rail, Lightning Arresters, Battery set, Battery Chargers, Insulators, ACDB & DCDB, drop Jumpers, Conductor busbar, Termination Assemblies, D.O fuse assembly, GI Earth Strip etc to complete the work.	Supply of all other balance material including cables, AL/CU Busbars, Earthing material, Buried rail, Lightning Arresters, Battery set, Battery Chargers, Insulators, ACDB & DCDB, drop Jumpers, Conductor busbar, Termination Assemblies, D.O fuse assembly, GI Earth Strip etc to complete the work.	17.00
E 4.6 Foundation	E 4.6.1	Completion of Earthwork, fencing and foundation work	Completion of Earthwork, fencing and foundation work	3.63
E 4.7 Control Room Building	E 4.7.1	Construction of control room building, inside road and its E&M works i.e Building electrification, Ventilation, Access control system and switch yard lighting including trenching, oil soak pit, water recharge pit & drainage works etc.	Construction of control room building, inside road and its E&M works i.e Building electrification, Ventilation, Access control system and switch yard lighting including trenching, oil soak pit, water recharge pit & drainage works etc.	1.72

Cost Centre		Sectioning Post (SP)		
Weightage of Cost Centre 'E4', (X)		5.67%		
Sub Cost Centre	Item of work		Milestone	Weightage (Y) (%)
	No	Description		
E 4.8 Erection of Ferrous Item	E 4.8.1	Erection of Steel structures and SPS	Erection of Steel structures and SPS	0.10
E 4.9 Erection of Auto Transformer	E 4.9.1	Erection of Auto Transformers and 25KV/240V Auxillary Transformers	Erection of Auto Transformers and 25KV/240V Auxillary Transformers	1.00
E 4.10 Erection of CB, CT, PT & Isolator	E 4.10.1	Erection of Switchgears and control gears, Circuit Breaker, interrupters, Isolators, CT, PT, Control Cables and Erection & Commissioning of Control & Relay panel and control cabling .	Erection of Switchgears and control gears, Circuit Breaker, interrupters, Isolators, CT, PT, Control Cables and Erection & Commissioning of Control & Relay panel and control cabling .	0.70
E 4.11 Balance Materials	E 4.11.1	Erection of all other balance indoor/outdoor equipment including Bus-bars, Earth mat/Earthing & Bonding system, Buried rail, Lighting Protection system, Insulators, Fire Extinguisher, Power Distribution boards, Cabling, Battery, Battery chargers, Signage, GI Earth Strip & safety equipment etc. as required for commissioning of Power Supply installation	Erection of all other balance indoor/outdoor equipment including Bus-bars, Earth mat/Earthing & Bonding system, Buried rail, Lighting Protection system, Insulators, Fire Extinguisher, Power Distribution boards, Cabling, Battery, Battery chargers, Signage, GI Earth Strip & safety equipment etc. as required for commissioning of Power Supply installation	0.40
E 4.12 Testing and Commissioning	E 4.12.1	Number plates, Other facilities, EIG Sanction and Testing and Commissioning of all equipment and Energisation.	Number plates, Other facilities, EIG Sanction and Testing and Commissioning of all equipment and Energisation.	1.95
Total				100.00

Notes:

- The value of each Milestones will be total lump sum accepted cost of Works for Schedule 'A' (LS) multiplied by X * Y. For example, the value of Milestone E2.1.1 will be equal to $LS * X * Y = LS * 0.0567 * 0.0165$

- 2 Adjustment to Contract Price pursuant to GCC 13.7 shall be applicable to the payments of Works executed under this Cost Centre.
- 3 Payment will be made on *pro rata basis* as per weightage(s) given in this Cost Centre.

5.2.5 Stages of Payment i.e. Milestones of Cost Centre 'E5'- Sub Sectioning Post (SSP)

Cost Centre		Sub Sectioning Post (SSP)		
Weightage of Cost Centre 'E5', (X)		5.33%		
Sub Cost Centre	Item of Work		Milestone	Weightage (Y) (%)
	No	Description		
E 5.1 Ferrous Item	E 5.1.1	Supply of Steel structures and Small Parts Steel (SPS)	Supply of Steel structures and Small Parts Steel (SPS)	2.90
E 5.2 Auto Transformer	E 5.2.1	Supply of Auto Transformers and 25KV/240V LT Auxiliary Transformers	Supply of Auto Transformers and 25KV/240V LT Auxiliary Transformers	49.00
E 5.3 Circuit Breaker, Current Transformer, Potential Transformer & Isolator	E 5.3.1	Supply of Switchgears and control gears, Circuit Breaker, interrupters, CT, PT and isolators.	Supply of Switchgears and control gears, Circuit Breaker, interrupters, CT, PT and isolators.	16.30
E 5.4 Control Relays Panels	E 5.4.1	Supply of Control and Relays Panels with protective relays and earth fault locator panel.	Supply of Control and Relays Panels with protective relays and earth fault locator panel.	11.00
E 5.5 Balance Materials	E 5.5.1	Supply of all other balance material including cables, AL/CU Busbars, Earthing material, Buried rail, Lightning Arresters, Battery set, Battery Chargers, Insulators, ACDB & DCDB, drop Jumpers, Conductor busbar, connectors and Splices, Termination assemblies, GI Earth Strip etc. to complete the work.	Supply of all other balance material including cables, AL/CU Busbars, Earthing material, Buried rail, Lightning Arresters, Battery set, Battery Chargers, Insulators, ACDB & DCDB, drop Jumpers, Conductor busbar, connectors and Splices, Termination assemblies, GI Earth Strip etc. to complete the work.	7.80
E 5.6 Foundation	E 5.6.1	Completion of Earthwork, fencing and foundation work	Completion of Earthwork, fencing and foundation work	5.10
E 5.7 Control Room Building	E 5.7.1	Construction of control room building, inside road and its E&M works i.e Building electrification, Ventilation, Access control system and switch yard lighting including trenching, oil soak pit, water	Construction of control room building, inside road and its E&M works i.e Building electrification, Ventilation, Access control system and switch yard lighting including trenching, oil soak pit, water	3.10

Cost Centre		Sub Sectioning Post (SSP)		
Weightage of Cost Centre 'E5', (X)		5.33%		
		recharge pit & drainage works etc.	recharge pit & drainage works etc.	
E 5.8 Erection of Ferrous Item	E 5.8.1	Erection of Steel structures and SPS	Erection of Steel structures and SPS	0.20
E 5.9 Erection of Auto Transformer	E 5.9.1	Erection of Auto Transformers and 25KV/240V Auxillary Transformers	Erection of Auto Transformers and 25KV/240V Auxillary Transformers	1.00
E 5.10 Erection of CB, CT, PT & Isolator	E 5.10.1	Erection of Switchgears and control gears, Circuit Breaker, interrupters, Isolators, CT, PT, Control Cables and Erection relay panel and control cabling.	Erection of Switchgears and control gears, Circuit Breaker, interrupters, Isolators, CT, PT, Control Cables and Erection relay panel and control cabling .	1.00
E 5.11 Balance Materials	E 5.11.1	Erection of all other balance indoor/outdoor equipment including Bus-bars, Earth mat/Earthing & Bonding system, Buried rail, Lighting Protection system, Insulators, Fire Extinguisher, Power Distribution boards, Cabling, Battery, Battery chargers, Signage, GI Earth Strip & safety equipment etc. as required for commissioning of Power Supply installation	Erection of all other balance indoor/outdoor equipment including Bus-bars, Earth mat/Earthing & Bonding system, Buried rail, Lighting Protection system, Insulators, Fire Extinguisher, Power Distribution boards, Cabling, Battery, Battery chargers, Signage, GI Earth Strip & safety equipment etc. as required for commissioning of Power Supply installation	0.60
E 5.12 Testing and Commissioning	E 5.12.1	Number plates, Other facilities, EIG Sanction and Testing and Commissioning of all equipment and Energisation.	Number plates, Other facilities, EIG Sanction and Testing and Commissioning of all equipment and Energisation.	2.00
Total				100.00

Notes:

- 1 The value of each Milestones will be total lump sum accepted cost of Works for Schedule 'A' (LS) multiplied by X * Y. For example, the value of Milestone E5.1.1 will be equal to $LS * X * Y = LS * 0.0533 * 0.0290$
- 2 Adjustment to Contract Price pursuant to GCC 13.7 shall be applicable to the payments of Works executed under this Cost Centre.
- 3 Payment will be made on pro rata *basis* as per weightage(s) given in this Cost Centre.

5.2.6 Stages of Payment i.e. Milestones of Cost Centre 'E6'- SCADA

Cost Centre		SCADA		
Weightage of Cost Centre 'E6', (X)		1.05%		
Sub Cost Centre	Item of work		Milestone	Weightage (Y) (%)
	No	Description		
E6.1 SCADA system Hardware	E 6.1.1	Supply and erection of SCADA system Hardware, Web server, UPS, Battery sets, GPS receiver, Earthing and Furniture along with associated equipment/materials at OCC.	Supply and erection of SCADA system Hardware, Web server, UPS, Battery sets, GPS receiver, Earthing and Furniture along with associated equipment/materials at OCC.	23.00
E6.2 SCADA software at remote control centre of boundary post of Northern Railway and DFFCIL	E 6.2.1	Installation of software of SCADA system and modifications/ Upgradation of SCADA software at remote control centre of boundary post of Northern Railway and DFFCIL	Installation of software of SCADA system and modifications/ Upgradation of SCADA software at remote control centre of boundary post of Northern Railway and DFFCIL	11.00
E6.3 RTU for TSS, SP & SSP	E 6.3.1	Supply and erection of Remote Terminal Units(RTUs) along with	Supply and erection of Remote Terminal Units(RTUs) along with	64.00
E 6.4 Testing & Commissioning	E 6.4.1	System Acceptance Testing and commissioning of SCADA system including Integrated Testing	System Acceptance Testing and commissioning of SCADA system including Integrated Testing	2.00
Total				100.00

Notes:

- 1 The value of each Milestones will be total lump sum accepted cost of Works for Schedule 'A' (LS) multiplied by X * Y. For example, the value of Milestone E6.1.1 will be equal to $LS * X * Y = LS * 0.0105 * 0.23$
- 2 Adjustment to Contract Price pursuant to GCC 13.7 shall be applicable to the payments of Works executed under this Cost Centre.
- 3 Payment will be made on pro rata completion of each Milestone as per weightage given in this Cost Centre.

5.2.7 Stages of Payment i.e. Milestones of Cost Centre 'E7'- Spares and Tools

Stages of Payment i.e. Milestones of Cost Centre 'E7'- Spares and Tools				
Cost Centre		Spares and Tools		
Weightage of Cost Centre 'E7', (X)		3.63%		
Sub Cost Centre	Item of Work		Milestone	Weightage (Y) (%)
	No.	Description		
E 7.1 Supply of Spares for OHE works	E 7.1.1	OHE & ROCS conductors, Jumpers, Droppers and OHE Fittings etc.	OHE & ROCS conductors, Jumpers, Droppers and OHE Fittings etc.	10.98
	E 7.1.2	Steel Structures	Steel Structures	6.16
	E 7.1.3	Cantilevers with Insulators	Cantilevers with Insulators	5.66
	E 7.1.4	Tower Wagons(90% payment on supply and rest 10% on successful commissioning of Tower Wagon	Tower Wagons(90% payment on supply and rest 10% on successful commissioning of Tower Wagon	38.26
	E 7.1.5	Balance items	Balance items	3.87
E7.2 Supply of Spares for Traction Power Installation:	E 7.2.1	Auto Transformers & Transformer spare parts	Auto Transformers & Transformer spare parts	15.80
	E 7.2.2	Interruption	Interruption	4.54
	E 7.2.3	Circuit Breakers	Circuit Breakers	4.54
	E 7.2.4	Isolators	Isolators	2.24
	E 7.2.5	Balance items	Balance items	2.24
E 7.3 Special Tools & instruments/ Equipment,	E 7.3.1	Supply of Special Tools & instruments/ Equipment, Drone etc	Supply of Special Tools & instruments/ Equipment, Drone etc	4.59
	E 7.3.2	Supply of Portable diagnostic modules for SCADA	Supply of Portable diagnostic modules for SCADA	1.12
Total				100.00

Notes:

- 1** The value of each Milestones will be total lump sum accepted cost of Works for Schedule 'A' (LS) multiplied by X * Y. For example, the value of Milestone E7.1.1 will be equal to $LS * X * Y = LS \times 0.0363 \times 0.1098$
- 2** Adjustment to Contract Price pursuant to GCC 13.7 shall NOT be applicable to the payments of Works executed under Sub Cost Centre E 7.3.
- 3** Payment will be made on pro rata *basis* as per weightage(s) given in this Cost Centre.

5.2.8 Stages of Payment i.e. Milestones of Cost Centre 'E8'- Annual Maintenance Contract (Comprehensive) for 3 Years

Cost Centre		Annual Maintenance Contract (Comprehensive) For 3 Years		
Weightage of Cost Centre 'E8', (X)		7.88%		
Sub Cost Centre	Item of Work		Milestone	Weightage (Y) (%)
	No	Description		
E 8.1 First Year Comprehensive Maintenance	E 8.1.1	Price of First year of Comprehensive Maintenance Contract	Price of First year of Comprehensive Maintenance Contract	31.00
E 8.2 Second Year Comprehensive Maintenance	E 8.1.2	Price of Second year of Comprehensive Maintenance Contract	Price of Second year of Comprehensive Maintenance Contract	33.00
E 8.3 Third Year Comprehensive Maintenance	E 8.1.3	Price of Third year of Comprehensive Maintenance Contract	Price of Third year of Comprehensive Maintenance Contract	36.00
Total				100.00

Notes:

- 1 The value of each Milestones will be total lump sum accepted cost of Works for Schedule 'A' (LS) multiplied by X * Y. For example, the value of Milestone E8.1.1 will be equal to $LS * X * Y = LS * 0.0788 * 0.31$
- 2 Adjustment to Contract Price pursuant to GCC 13.7 shall NOT be applicable to the payments of Works executed under this Cost Centre.
- 3 Payment will be made on completion of each Milestone as per weightage given in this Cost Centre.
- 4 The yearly amount shall be divided into 12 equal instalments and shall be paid on monthly basis after Certification by the Engineer.

5.3 Schedule 'B' OHE works for IR Connectivity and Feeder (Harsana Kalan IR SSP to New Harsana Kalan OHE)

Schedule 'B' is subdivided into eight Sub-Schedules as given below:

S. No.	Sub-Schedule	Description	No. of Items	Material (M) (INR)	Erection (E) (INR)	Total (INR)
1	2	3	4	5	6	7=5+6
1	B1	General	71	5,35,48,996.48	86,56,360.25	6,22,05,356.72
2	B2	Concrete	6	1,77,99,799.48	39,55,897.31	2,17,55,696.79
3	B3	Ferrous	27	5,63,53,342.11	40,28,799.76	6,03,82,141.87
4	B4	Non Ferrous	29	1,86,89,084.64	12,90,687.09	1,99,79,771.73
5	B5	Contact & Catenary wire	2	4,73,84,107.67	-	4,73,84,107.67
6	B6	Insulators	6	1,49,68,948.95	-	1,49,68,948.95
7	B7	SCADA at Harsana Kalan IR SSP	3	18,89,146.86	-	18,89,146.86
8	B8	Non- Schedule (NS) Items	16	1,36,54,013.00	-	1,36,54,013.00
Grand Total for IR & DFC Connectivity in INR						24,22,19,183.59

5.3.1 Sub-Schedule ‘B1’: General

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
1 (a)	Preparation of designs and drawings for overhead equipment, TSWR and as built drawings. All designs, LOP, CSD, Foundations, cable trench, gantry connections, FOB, ROB, SPS, Turnout, Cross Overs, Overlaps, PTFE, fencing, gate, earthing, control room building, gantry for interrupter, motorised Isolators etc including cross feeder and along feeders etc required for OHE works and SP at Sultanpur and Asaudah.	TKM	0.00	17,175.77	13.956	0.00	2,39,705.05	2,39,705.05
1(b)	Preparation of design and drawing for switching station Gantry, Locations, modifications in cross feeder, earthing, drop jumpers etc. Supply of as-built drawings in 6 hard copies and soft copies (cad and PDF) for DFC Prithla South SSP	LS	0.00	29,504.31	1	0.00	29,504.31	29,504.31
2	Supply (without insulator) and erection of mounting arrangements for span wire. All components including adjusters, terminal fitting and mast attachments required to attach a span wire or a head span wire or a cross span wire or a support span wire for supporting contact wire to the structure.	Each	6272.86	797.76	10	62,728.60	7,977.60	70,706.20

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
3	Marking/painting of temperature & 'Y'- Measurement of OHE mast at BWA locations including cost of paint	Each	0.00	113.97	36	0.00	4,102.92	4,102.92
4 (a)	Supply (without insulator) and erection of material for termination of Single conductor of Overhead equipment or terminating wire including terminating wire on structure along with mast anchor fittings, clevis assembly, adjuster, anchor double strap, ending clamp for catenary or contact wire and fittings including 9 ton assembly fitting.	Each	4727.68	749.97	8	37,821.44	5,999.76	43,821.20
4 (b)	Extra on erection under power block @100% on Item 4 (a)	Each	0.00	749.97	4	0.00	2,999.88	2,999.88
5	Supply without Insulator and erection of material for termination of all 25KV Feeder / return conductor including all materials required for termination along with mast anchor fitting, adjuster, strain clamp and fitting and 9-ton insulator assembly.	Each	5966.96	749.97	14	83,537.44	10,499.58	94,037.02
6 (a)	Supply (without insulator) and erection of anti-creep with Galvanised Steel wire including all materials for anticreep including adjuster, mast anchor fitting at its termination on either side, structure ending clamp, fittings etc	Each	5474.78	2420.86	10	54,747.80	24,208.60	78,956.40
6 (b)	Extra on erection under power block @100% on Item 6 (a)	Each	0.00	2420.86	5	0.00	12,104.30	12,104.30

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
7 (a)	Supply (without insulator) and erection of cut-in (9Tonne) Insulator including components required for cut-in insulators assembly, Terminal fittings for conductor etc.	Each	1349.09	520.17	418	5,63,919.62	2,17,431.06	7,81,350.68
7 (b)	Extra on erection under power block @100% on Item 7(a)	Each	0.00	520.17	218	0.00	1,13,397.06	1,13,397.06
8	Supply (without insulator) and erection of a suspension (9 Tonne) Insulator including 9 ton suspension insulator assembly for suspension of feeder wire etc including supply of all components, clamps, nuts bolts etc. including armour tape.	Each	1398.11	308.81	21	29,360.31	6,485.01	35,845.32
9	Supply (without insulator) and erection of 25 kV Post Insulator including supply of all components and fittings, (Out rigger) support jumpers including nuts bolts etc	Each	1009.85	238.96	32	32,315.20	7,646.72	39,961.92
10 (a)	Transfer of equipment from one mast or support to another including dismantling of erected bracket from old structure and consequent adjustment to OHE require such as respacing of dropper (including cost of dropper wire) levelling etc.	Each	1576.55	2167.18	166	2,61,707.30	3,59,751.88	6,21,459.18
10 (b)	Extra on erection under power block @100% on Item 10 (a)	Each	0.00	2167.18	166	0.00	3,59,751.88	3,59,751.88

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
11 (a)	Erection of an additional bracket assembly/ assemblies on a mast or support include dismantling of an existing bracket assembly and erection of multiple cross arm wherever required and erection of bracket assembly on multiple cantilever cross arm along with any consequential adjustment to traction overhead such as respacing of droppers, levelling including nut, bolts, washers etc.	Each	0.00	1924.55	170	0.00	3,27,173.50	3,27,173.50
11 (b)	Extra on erection under power block @100% on Item 11 (a)	Each	0.00	1924.55	170	0.00	3,27,173.50	3,27,173.50
12 (a)	Re-adjustment of head-span include readjustment of headspan to enable the additional equipment to be suspended form headspan.	Each	0.00	2124.91	100	0.00	2,12,491.00	2,12,491.00
12 (b)	Extra on erection under power block @100% on Item 12 (a)	Each	0.00	2124.91	100	0.00	2,12,491.00	2,12,491.00
13 (a)	Dismantling of overhead equipment (Catenary, Contact, Dropper, Cantilever, Jumpers, Connectors and 9 Ton Insulator) include dismantling of equipment along with termination, tensioning devices, guy rod assemblies, bracket assemblies, associated SPS etc.	Km	0.00	11437.03	2	0.00	22,874.06	22,874.06
13 (b)	Extra on erection under power block @100% on Item 13 (a)	Km	0.00	11437.03	2	0.00	22,874.06	22,874.06

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
14 (a)	Dismantling of Feeder/ Return Conductor including guy rods, terminations, suspension assemblies, super mast and associated SPS.	Km	0.00	4957.52	0.5	0.00	2,478.76	2,478.76
14 (b)	Extra on erection under power block @100% on Item 14 (a)	Km	0.00	4957.52	0.5	0.00	2,478.76	2,478.76
15 (a)	Splicing & extension of an anchored overhead equipment include splicing of terminated overhead equipment for extension and consequent adjustment of affected equipment. The extended overhead equipment shall be deemed as starting from the centre line of the structure preceding the old terminating structure and the extended overhead equipment including nuts, bolts and washers etc.	Each	0.00	2124.91	20	0.00	42,498.20	42,498.20
15 (b)	Extra on erection under power block @100% on Item 15 (a)	Each	0.00	2124.91	20	0.00	42,498.20	42,498.20
16 (a)	Dismantling of a Section Insulator Assembly include dismantling of contact wire, catenary wire, droppers and dismantling of section insulator and splicing of catenary/ contact wire and necessary adjustment to droppers (including dropper material).	Each	1313.79	2124.91	10	13,137.90	21,249.10	34,387.00

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
16 (b)	Extra on erection under power block @100% on Item 16 (a)	Each	0.00	2124.91	10	0.00	21,249.10	21,249.10
17	Slewing and putting back of OHE in original shape include temporary slewing or lowering of erected OHE and/ or on adjusted to ground for special work and restoration and readjustment of the equipment after completion of special works.	Span	0.00	1722.36	50	0.00	86,118.00	86,118.00
18	Dismantling of Guy Rod include dismantling of all fittings and SPS.	Each	0.00	694.09	50	0.00	34,704.50	34,704.50
19 (a)	Dismantling of Cantilever include dismantling of catenary/contact wire, anticreep wire (if any), fitting and SPS supporting the cantilever.	Each	0.00	687.03	110	0.00	75,573.30	75,573.30
19 (b)	Extra on Dismantling under power block @100% on Item 19 (a)	Each	0.00	687.03	110	0.00	75,573.30	75,573.30
20 (a)	Dismantling of Mast/TTC/Gantry include dismantling of foundation 150 mm below the ground level and cutting of mast/structure and finishing the ground by proper compaction and stacking of Mast/Gantry properly. (Dismantled Materials shall be handed over to IR/DFC in store.	MT	0.00	4587.13	20	0.00	91,742.60	91,742.60
20 (b)	Extra on Dismantling under power block @100% on Item 20 (a)	MT	0.00	4587.13	20	0.00	91,742.60	91,742.60

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
21 (a)	Dismantling of Portal include Dismantling of foundation 150 mm below the ground level and cutting of portal and finishing the ground by proper compaction and stacking of portal, boom properly. Materials shall be handed over to IR/DFC in store.	MT	0.00	6426.00	10	0.00	64,260.00	64,260.00
21 (b)	Extra on Dismantling under power block @100% on Item 21 (a)	MT	0.00	6426.00	10	0.00	64,260.00	64,260.00
22 (a)	Dismantling of Copper/ Aluminium Jumper include dismantling of all clamps, PG clamps, nut bolt etc.	Each	0.00	360.00	20	0.00	7,200.00	7,200.00
22 (b)	Extra on Dismantling under power block @100% on Item 22 (b)	Each	0.00	360.00	20	0.00	7,200.00	7,200.00
23 (a)	Shifting of ATD with BWA from one mast/ Support to another including nut, bolts, washers etc.	each	0.00	3091.30	20	0.00	61,826.00	61,826.00
23 (b)	Extra on Dismantling under power block @100% on Item 23 (a)	Each	0.00	3091.30	20	0.00	61,826.00	61,826.00
24 (a)	Dismantling of ATD with BWA include all fittings, attachment and SPS and anchoring of OHE at Structure.	Each	0.00	2049.51	20	0.00	40,990.20	40,990.20
24 (b)	Extra on Dismantling under power block @100% on Item 24 (a)	Each	0.00	2049.51	20	0.00	40,990.20	40,990.20

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
25 (a)	Adjustment on Bracket Assembly for lower/raising the height of contact and catenary wire where encumbrance is changed	Each	0.00	2093.82	73	0.00	1,52,848.86	1,52,848.86
25 (b)	Extra on Dismantling under power block @100% on Item 25 (a)	Each	0.00	2093.82	73	0.00	1,52,848.86	1,52,848.86
26	Adjustment on Bracket Assembly for lowering /raising the height of contact and catenary wire where encumbrance is not changed	Each	0.00	1914.77	73	0.00	1,39,778.21	1,39,778.21
27 (a)	Dismantling OHE Termination Assembly including all fittings and SPS etc.	Each	0.00	1149.54	23	0.00	26,439.42	26,439.42
27 (b)	Extra on Dismantling under power block @100% on Item 27 (b)	Each	0.00	1149.54	23	0.00	26,439.42	26,439.42
28 (a)	Dismantling of anchor Assembly include dismantling of anchor terminations and SPS.	Each	0.00	894.76	20	0.00	17,895.20	17,895.20
28 (b)	Extra on Dismantling under power block @100% on Item	Each	0.00	894.76	20	0.00	17,895.20	17,895.20
29	Loading, Leading, Transportation, Unloading and stacking of steel structure, conductor, cantilever assembly, ATD, etc form dismantling site to concerned Engineer in charge store	MT	0.00	3343.50	100	0.00	3,34,350.00	3,34,350.00

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
30	Dismantling of an Isolator including dismantling of connections to the overhead equipment and associated SPS	Each	0.00	1152.53	10	0.00	11,525.30	11,525.30
31	Dismantling of a Post/ Pedestal Insulator including dismantling of connection to the overhead equipment and associated SPS.	Each	0.00	374.98	40	0.00	14,999.20	14,999.20
32	Loading of all type of Steel Structures include BFB/ RSJ, B -series, special structure, N,O & R type) tailor/ truck over and above the requirement given by the contractor for the completion of work or actual qty utilised in the completion of work.	MT	0.00	207.71	200	0.00	41,542.00	41,542.00
33	Unloading of all type of Steel Structures include BFB/ RSJ, B -series, special structure, N,O & R type) tailor/ truck over and above the requirement given by the contractor for the completion of work or actual qty utilised in the completion of work.	MT	0.00	112.13	200	0.00	22,426.00	22,426.00

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
34	Unloading of all type of Copper & Aluminium conductors include for all type of copper conductors (contact wire, catenary wire, dropper, bridle wire, jumpers etc) and aluminium conductors (spider conductors etc) into tower wagon/ trailer/truck over above the requirement given by contractor for the completion of work or actual qty utilised in the completion of work.	MT	0.00	101.10	12	0.00	1,213.20	1,213.20
35	Loading of all type of Copper & Aluminium conductors include for all type of copper conductors (contact wire, catenary wire, dropper, bridle wire, jumpers etc) and aluminium conductors (spider conductors etc) into tower wagon/ trailer/truck over above the requirement given by contractor for the completion of work or actual qty utilised in the completion of work.	MT	0.00	101.10	12	0.00	1,213.20	1,213.20
36	Supply and erection of copper control cables include installation and connecting up of cables for control and indication from the equipment (interrupter, motorised isolators etc) to the terminal board and terminal connectors at both end. If required to the conduits may be provided where it is necessary	m	394.14	12.87	7900	31,13,706.00	1,01,673.00	32,15,379.00

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
37	Supply and erection of LT power cables copper (for motorised isolators, interrupter and other applications) with route markers	m	425.51	18.38	7500	31,91,325.00	1,37,850.00	33,29,175.00
38	Excavation of trench for laying LT power cables and control cables with brick protection (class designation not below 7.5) and back filling with sand and earth etc with route marker as per drawing.	m	224.15	0.00	19,500	43,70,925.00	0.00	43,70,925.00
39	Supply and laying GI/HDPE pipe under road/ground/ floor/Railway Tracks in already excavated trench as per site and as per drawing.	m	369.39	0.00	400	1,47,756.00	0.00	1,47,756.00
40	Provision of wooden key box with glass front in frame with hinges	Nos	2701.00	0.00	4	10,804.00	0.00	10,804.00
41	Supply and erection of electric shock treatment chart and first aid coloured calendar	Nos	58.00	0.00	14	812.00	0.00	812.00
42	Supply and erection of protective screen include fabrication of protective screen and angle, Tee, expanded metal (jali), GI sheet, paints etc.	sqm	7684.47	830.48	100	7,68,447.00	83,048.00	8,51,495.00
43 (a)	Supply and erection of Aerial Earth Wire 92 sqmm ASCR including mast fittings and terminations.	TKM	56,651.63	2832.58	1.2	67,981.96	3,399.10	71,381.05
43 (b)	Extra on erection under power block @100% on item-43 (a)	TKM	0.00	2832.58	1.2	0.00	3,399.10	3,399.10

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
44 (a)	Supply and erection of Negative feeder Wire 288 sqmm AAAC	TKM	1,85,554.32	19,167.50	1.2	2,22,665.18	23,001.00	2,45,666.18
44 (b)	Extra on erection under power block @100% on item-44 (a)	TKM	0.00	19,167.50	1.2	0.00	23,001.00	23,001.00
45	Supply and erection of termination assembly for NFW	Nos	9698.00	987.00	0.756	7,331.69	746.17	8,077.86
46	Supply of suspension clamp assembly for NFW	Nos	2980.00	0.00	4	11,920.00	0.00	11,920.00
47	Supply (without insulator) and erection of material for termination of all 25KV Feeder / return conductor including all materials required for termination along with mast anchor fitting, adjuster, strain clamp and fitting and 9-ton insulator assembly.	Nos	5,967.02	749.90	6	35,802.12	4499.40	40,301.52
48 (a)	Supply (without insulator) and erection of materials for termination of copper cross feeder with gantries include mast anchor fitting, clavis, 9 ton adjuster, feeder ending clamp, double clavis and other component as necessary along with 9 ton insulator assembly and termination of cross feeder at either end. fitting component required for termination of one cross feeder at both ends constitute one set.	Set	5,676.81	749.90	22	1,24,889.82	16,497.80	1,41,387.62
48 (b)	Extra on erection under power block @100% on item No.69	Set	0.00	749.90	12	0.00	8998.80	8,998.80

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
48 (c)	Extra on Dismantling under power block @100% on Item 69 (Dismantled materials shall be handed over to DFC in store).	set	0.00	749.90	12	0.00	8998.80	8,998.80
49	Supply & Erection of 25kV Vacuum type Interrupter include single pole outdoor type interrupter and components and erection of the same complete with supporting frame and terminal connectors and grouting on foundation block etc. Including enabled number plate.	Nos	3,40,198.50	3,516.09	10	34,01,985.00	35,160.90	34,37,145.90
50	Supply and Erection of 25kV Potential Transformers Type-I include complete fitting with accessories, terminal connectors and fixing boards including enabled number plates with fixing bolts and all SPS.	Nos	87,193.38	788.50	9	7,84,740.42	7096.50	7,91,836.92
51	Supply and Erection of 42KV Lightning Arrestors (station class) include all fittings, accessories, and terminal connectors along with enabled number plate and all SPS.	Nos	29,646.85	510.96	8	2,37,174.80	4087.68	2,41,262.48
52	Supply and Erection of 7.5 KV Lightning Arrestors include all fittings accessories and terminal connectors along with enabled number plate and all SPS.	Nos	1,382.43	266.51	0	0	0	0.00

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
53	Supply and Erection of Terminal Boards in control cubicles include wall mounted terminal boards with six numbers of two-way terminal blocks for connecting the cables form the outdoor equipment.	Nos	9,924.11	374.95	3	29,772.33	1124.85	30,897.18
54	Supply and Erection of an Iron clad 15A, 110 V.D.C Fuse Box complete with 2 fuse carriers and bases.	Nos	3,123.71	86.39	3	9371.13	259.17	9,630.30
55	Supply and erection of an Iron clad 230 V.A.C Fuse Box. The fuse box shall contain 4 fuse carriers and bases.	Nos	3,455.11	86.39	3	10,365.33	259.17	10,624.50
56	Supply and Erection of Lead Acid Batteries. (40 AH) include 110 V, 40 AH laid acid batteries complete with stands, accessories, and tool board with all connectors. This will also include supply of electrolyte, tool board with thermometer, hydrometer, and wrench.	Nos	83,759.84	5,633.47	2	1,67,519.68	11266.94	1,78,786.62
57	Supply and Erection of Battery chargers for 110 V, 40 AH laid acid batteries complete with connecting lead and plug for connection to 230V AC supply.	Nos	81,547.95	768.28	2	1,63,095.90	1536.56	1,64,632.46

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
58	Supply and Installation of cables (copper) for Heater supply from interrupter to 230 V AC fuse box and from fuse box to LT distribution board inside the control cubicle and include terminal connectors at both ends.	Metre	186.29	12.87	400	74,516.00	5148.00	79,664.00
59	Supply and Installation of cables (copper) for Catenary indication from potential transformer to terminal board in the control cubicle including terminal connectors at both ends with all fasteners on structural members and conduit etc.	Metre	268.64	12.87	400	1,07,456.00	5148.00	1,12,604.00
60	Supply and Installation of cables (copper) for L.T. Power supply, laying in trenches, and connecting LT Power supply cable between LT supply auxiliary transformer at switching station and LT distribution board inside the control cubicle along with suitable cable boxes and connectors at both ends.	Metre	425.52	18.38	95	40,424.40	1746.10	42,170.50
61	Supply and Installation of copper cables for 110V D.C. supply between 110V battery charger and battery, between battery and the D.C fuse box and between D.C fuse box and terminal board including terminal connectors.	Metre	268.64	18.38	150	40,296.00	2757.00	43,053.00

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
62	Supply, Erection, oil- filtration, testing and commissioning of L.T. supply auxiliary transformers (25 kVA).	Nos	1,83,561.81	8,403.34	62	1,13,80,832.22	5,21,007.08	1,19,01,839.30
63	Supply, Erection, oil- filtration, testing and commissioning of L.T. supply auxiliary transformers (10 kVA).	Nos	67,906.00	11,320.00	0	0.00	0.00	0.00
64	Supply and laying of 2 core 70 sqmm, 1.1 kV grade LT XLPE insulated armoured copper conductor cable, making good the damages and termination with copper crimping socket/plug. Provision of cable route markers, testing and commissioning etc. Laying includes excavation of trench, filling the trench with earth/sand with protective bricks etc as per drawing, from auxiliary transformer to Panel Board.	m	737.80	184.15	0	0.00	0.00	0.00
65	Supply and laying of 2 core 130 sqmm, 1.1 kV grade LT XLPE insulated armoured copper conductor cable, making good the damages and termination with copper crimping socket/plug. Provision of cable route markers, testing and commissioning etc. Laying includes excavation of trench, filling the trench with earth/sand with protective bricks etc as per drawing, from auxiliary transformer to Panel Board.	m	1,521.63	184.15	12000	1,82,59,560.00	22,09,800.00	2,04,69,360.00

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
66	Supply and erection of Iron clad 230 V.A.C Fuse Box and mounting near auxiliary transformer on mast. The fuse box shall contain 2 nos. 63 A double pole MCB (one being spare). The GI pipe of 75 mm dia pipe about 2-3 m long as per site condition and having round bend at one end for cable exit 300 mm below the ground level and upper end properly sealed, shall be provided along with necessary clamps etc.	Nos	4,955.11	270.54	60	2,97,306.60	16,232.40	3,13,539.00
67	Supply without Insulator & erection of 25 kV D.O. fuse switch completes with all mounting accessories and terminal connectors.	Nos	9,675.08	439.28	62	5,99,854.96	27,235.36	6,27,090.32

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
68	Supply and Erection of materials for internal and external lighting of Switching Station Building (SP/SSP). This includes fixing of GI conduit on wall and drawings of wire circuit with cast iron switch boxes concealed in wall with switches plug etc. provision of main board and distribution board and connections. provision of light fittings, exhaust fan, outdoor luminaires complete with tubes, bulb etc. Provision of earthing station and connection between earthing station to main board with 8 SWG GI wire. All material i.e., light fitting, exhaust fan switch sockets, sealing rose etc shall be ISI mark. Provision of 150-watt HPSV streetlight fitting complete in respect including lamp on wall of the building, complete testing of wiring and earthing etc.	Nos	25,752.11	6,034.52	3	77,256.33	18,103.56	95,359.89
69	Design and drawings for Modification in Harsana Kalan IR SSP and Feeders from Harsana Kalan IR SSP to New Harsana Kalan HORC OHE (Feeder Length Approximate 5 TKM)	Nos	33,147.30	0.00	0	0.00	0.00	0.00
70 (a)	Shifting and modification to terminalisation of aluminium cross feeder from SSP tower to gantries (slack feeder) including ending cone and fittings etc. (for DFC Prithla south SSP).	set	0.00	749.90	12	0.00	8998.80	8,998.80

SUB-SCHEDULE 'B1': GENERAL								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
70 (b)	Extra on Shifting under power block @100% on Item 91	set	0.00	749.90	12	0.00	8998.80	8,998.80
71	Supply, Erection, Testing in commissioning of control and distribution panel (Auto change over) for colour light signalling for 25 kVA AT supply in 25 kV AC traction system as per RDSO technical specification TI/SPS/PSI/CLS/0020(Amendment-4 or latest).	Nos	77,563.80	15,512.76	60	46,53,828.00	9,30,765.60	55,84,593.60
Total of Sub-Schedule 'B1': General						5,35,48,996.48	86,56,360.25	6,22,05,356.72

5.3.2 Sub-Schedule 'B2': Concrete

SUB-SCHEDULE 'B2': CONCRETE								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
1	Supply and Erection of concrete of foundation and Plinth in all type of soil using M-20 Grade concrete for Main Foundation and M -20 for Grouting and Muffing including Reinforcement along with excavation, dressing, and compaction of earth etc.	Cum.	9458.66	2102.90	1770	1,67,41,828.20	37,22,133.00	2,04,63,961.00
2	Supply of materials and construction of Super Structure of SP/SSP building (Control cubicles) include RCC work including reinforcement precast RCC slab, concrete flooring, cable trench, brick masonry, plastering work, doors, window grills, rolling shutter, water pipe line ventilators and painting, white washing and colour washing, acid proof or painting of floor and wall in battery room, spreading of stone metal, provision of RCC pipe etc. The window glasses shall be minimum 5 mm thick toughened glass, plastering work 1: 4 cement sand ratio, minimum concrete grade M-20 and minimum brick compressive strength class 10.	Nos	2,15,951.91	50639.47	3	6,47,855.73	1,51,918.41	7,99,774.00
3	Brick work in foundation plinth, retaining walls and drainage. Brick class designation minimum 10.	Cum.	3191.80	748.46	100	3,19,180.00	74,846.00	3,94,026.00

SUB-SCHEDULE 'B2': CONCRETE								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
4	Plastering of retaining wall with 1:4 cement & sand mortar. (Erection include material)	Sqm	95.52	22.40	300	28,656.00	6,720.00	35,376.00
5	Supply & Spreading of Ballast/Gravel in the Switch Yard of 20 mm nominal size (single sized) and having minimum 150 mm layer depth on the finished ground	Sqm	1144.19	6.22	45	51,488.55	279.90	51,768.00
6	Earth work in excavation and dumping at site of SSP/SP upto required level include all material and labour, necessary tools & plants including transportation, watering, ramming, levelling, and compaction to more than 95%.	cum	107.91		100	10,791.00	0.00	10,791.00
Total of Sub-Schedule 'B2': Concrete						1,77,99,799.48	39,55,897.31	2,17,55,696.79

5.3.3 Sub-Schedule 'B3': Ferrous

SUB-SCHEDULE 'B3': FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
1	Supply and erection of fabricated and galvanised structures ((O, N & R type portals and Gantry portal (600x600mm) with all necessary components. Portal for High rise OHE include Erection, Alignment and setting before grouting, wherever required of portals assembly of boom components and erection of the same including galvanised bolts, nuts, washers etc.	MT	1,40,052.71	8561.82	120	1,68,06,325.20	10,27,418.40	1,78,33,743.60
2	Extra on erection under power block @100% on Item 1 erection of steel	MT	0.00	8561.82	65	0.00	5,56,518.30	5,56,518.30
3	Supply and erection of Structure steel (traction masts) fabricated and galvanised of all Type: B-Series Mast. B- series Traction mast for conventional and high-rise OHE include Erection, Alignment and setting before grouting of individual traction mast	MT	1,18,127.05	2503.84	177.12	2,09,22,663.10	4,43,480.14	2,13,66,143.24
4	Extra on erection under power block @100% on Item 3 erection of steel	MT	0.00	2503.84	92	0.00	2,30,353.28	2,30,353.28
5	Supply only of fabricated steel other than masts (SPS)	MT	1,72,307.95	0.00	16.96	29,22,342.83	0.00	29,22,342.83

SUB-SCHEDULE 'B3': FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
6	Supply and erection of a Guy Rod Assembly include both conventional and High rise OHE, of various lengths for traction masts, feeder line towers or supports complete with mast/ portal guy rod fittings, guy rod with adjustments and parts be grouted in the anchor block and erection of dwarf or stub mast with anchor plates drilled and welded in position, where required, for anchorage, SPS works, complete with bolts and nuts etc.	Each	10626.05	1142.06	72	7,65,075.60	82,228.32	8,47,303.92
7	Supply and erection of 25 kV Caution Boards, Warning Board, Number Plate, PTFE Board, Sigma Board etc. including all type boards, SPS items, nuts, bolts etc	Each	340.68	101.41	168	57,234.24	17,036.88	74,271.12
8	Supply without insulator and erection of Single bracket assembly on the traction mast or support on drop arm and shall include those on high/low level platform, in the vicinity on the turnouts, over bridges or and at locations with reduced encumbrance or terminating wires. All components including galvanised steel tubes, dropper wires, bolts and nut etc.	Each	14911.84	1035.82	319	47,56,876.96	3,30,426.58	50,87,303.54
9	Extra on erection under power block @100% on item 8	Each	0.00	1035.82	181	0.00	1,87,483.42	1,87,483.42

SUB-SCHEDULE 'B3': FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
10	Supply and erection of Regulating Equipment ATD (3-Pulley type) with counter weight assembly for conventional/Regulated OHE 2400 Kgf Tension include counter weight assembly (for both conventional and high rise OHE) including 9 Ton adjuster with double strap assembly normal/ anti-theft guide tube assembly and regulating equipment and stainless steel wire rope(various length as required) required for the regulating equipment and SPS works including nuts, bolts, washers etc.	Each	83702.91	4259.18	33	27,62,196.03	1,40,552.94	29,02,748.97
11	Extra on erection under power block @100% on item 8	Each	0.00	4259.18	18	0.00	76,665.24	76,665.24
12	Supply without Insulator and erection of materials for termination of Double conductor include all materials necessary for the termination of two overhead equipment conductors on a traction mast or structure, including appropriate mast anchoring, clavis assembly, two adjusters, ending clamps for catenary and contact wires, anchor double strap assembly, equalising/ compensating plate and fittings including 9- ton insulator (cost of insulator will be paid in section-5) assembly and terminating wire if any.	Each	10883.51	1132.40	49	5,33,291.99	55,487.60	5,88,779.59

SUB-SCHEDULE 'B3': FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
13	Extra on erection under power block @100% on item 12	Each	0.00	1132.40	25	0.00	28,310.00	28,310.00
14	Supply and erection of a structure bond include GI flat (40x 6 mm) required to provide a structure bond connecting a traction mast or structures to the nearest non-track circuited rail, or earth electrode, including shaping and drilling of the bond and erection of all fasteners (GI) at both ends. provision of heat shrinkable PVC tube for structure bond under track circuit rail.	Each	1373.12	316.30	307	4,21,547.84	97,104.10	5,18,651.94
15	Supply and erection of a longitudinal bond including GI flat (40x 6 mm), GI fasteners etc. required to provide longitudinal bond connecting two rails at the rail joint at the locations including shaping and drilling of the bond and erection of all fasteners at both ends.	Each	774.98	282.50	60	46,498.80	16,950.00	63,448.80
16	Supply & erection of a transverse and special bond including GI flats (50x 6 mm), fasteners etc. required to provide transverse bond connecting rails of the same/ adjacent tracks at locations. Including GI flat to provide special bonds at level crossing, FOB, ROB, bridge/protective screen etc. including shaping and drilling of the bond and erection of all fasteners at both ends	Each	1765.81	338.03	31	54,740.11	10,478.93	65,219.04

SUB-SCHEDULE 'B3': FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
17	Supply & erection of a steel Rod Copper clad 3 m Long, 19.3 mm dia earth electrode include embedded into the ground by driving or otherwise complete with protective concrete box and lugs suitable for directly connecting to GI flat.	Each	3097.31	1202.42	343	10,62,377.33	4,12,430.06	14,74,807.39
18	Supply and erection of earth bus for PTFE, Auxiliary Transformer etc include GI flats (50 x 6 mm) for providing earth bus. The earth bus buried at a depth of 300 mm below ground level. It shall be include connecting the earth bus to earth electrode and to various floor or wall mounted equipment or structure to be earthed and also connections to non-track circuited rail, wherever required. The connection of earth strip to each strip to each other shall be made either by riveting or by welding. The connection of earth strip to various equipment, structures, fencing shall be made with GI bolts, nuts, spring washer, locknuts etc.	Metre	327.68	84.51	21	6,881.28	1,774.71	8,655.99
19	Supply and erection of galvanised traction masts, main masts of switching stations fabricated in various lengths.	MT	1,10,502.09	2,503.84	10	11,05,020.90	25,038.40	11,30,059.30

SUB-SCHEDULE 'B3': FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
20	Supply & erection of a single earth electrode copper clad steel rod 19.3 mm dia and minimum 3 mtr length including excavation, back filling and compaction of earth with all connectors	Nos	3,097.31	1,202.42	128	3,96,455.68	1,53,909.80	5,50,365.44
21	Supply and erection of earth bus for include GI flats (50 x 6 mm) for providing earth bus. The earth bus either buried at a depth of 300 mm below ground level. It shall be include connecting the earth bus to earth electrode and to various floor or wall mounted equipment or structure to be earthed and connections to non-track circuited rail, wherever required. The connection of earth strip to each strip to each other shall be made either by riveting or by welding. The connection of earth strip to various equipment, structures, fencing shall be made with GI bolts, nuts, spring washer, locknuts. etc.	Metre	327.68	84.51	500	1,63,840.00	42,255.00	2,06,095.00
22	Supply and erection of 8 SWG G.I. wire for earthing	Metre	28.61	21.73	100	2861.00	2173.00	5,034.00
23	Supply and erection of fencing panels at switching stations include GI fencing panels as per drawing with height of 2.4 mtr with all GI fasteners etc	Metre	5,976.18	94.17	400	23,90,472.00	37,668.00	24,28,140.00
24	Supply and erection of fencing GI uprights and embedded in foundation as per drawing	MT	1,65,270.73	4,512.70	6	9,91,624.38	27,076.20	10,18,700.58

SUB-SCHEDULE 'B3': FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
25	Supply and erection of anticlimbing device for Switching stations include galvanised steel fixtures mounted on fencing panels and GI barbed wire as per drawing	Metre	397.89	9.66	100	39,789.00	966.00	40,755.00
26	Supply and erection of anticlimbing device for L.T. Supply Transformer Stations. Include galvanised steel fixtures mounted on fencing panels and GI barbed wire.	Nos	1,651.38	357.35	64	1,05,688.32	22,870.40	1,28,558.72
27	Supply and erection of anti-monkey menace. Include hot dipped galvanised wire with GI angle 16 x16x8 mm with all GI bolts nuts barbed wire etc.	Nos	6,589.92	357.35	6	39,539.52	2144.10	41,683.62
Total of Sub-Schedule 'B3': Ferrous						5,63,53,342.11	40,28,799.76	6,03,82,141.87

5.3.4 Sub-Schedule 'B4': Non-Ferrous

SUB-SCHEDULE 'B4': NON-FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
1 (a)	Supply and erection of large span wire (150 sqmm).150 sqmm Jumper specification shall DIN 43138 or Latest RDSO specification.	Metre	1147.65	51.25	2200	25,24,830.00	1,12,750.00	26,37,580.00
1 (b)	Extra on erection under power block @100% on item 1 (a)	Metre	0.00	51.25	700	0.00	35,875.00	35,875.00
2 (a)	Erection of Contact wire, Catenary wire, Large Span wire and Supply and erection of Droppers, Jumpers, PG Clamps, Splices, parallel clamp, dropper clip with Nut Bolts, ending clamps, anchor, large span wire clamp, 9 ton adjuster, anchor double strap assembly, compensating/ equalising plate etc.	KM	1,07,747.91	30100.63	14	15,08,470.74	4,21,408.82	19,29,879.56
2 (b)	Extra on erection under power block @100% on item 2 (a)	KM	0.00	30100.63	7	0.00	2,10,704.41	2,10,704.41

SUB-SCHEDULE 'B4': NON-FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
3	Supply and Erection of Copper 25KV Feeder/ Return conductor (150 sqmm) for cross feeder/along feeder including erection of suspension assembly, termination and SPS complete with nut bolt etc. 150 sqmm Jumper specification shall DIN 43138 or Latest RDSO specification.	KM	2,02,434.34	5512.10	5.24	10,60,755.94	28,883.40	10,89,639.35
4 (a)	Supply and Erection of 25KV copper 160 sqmm cross feeder (HDBC) conductor. PG clamps shall be provided in 2x160 sqmm feeder at an interval not more than 5 meters (2 Runs of 160 sqmm wire shall laid for each cross feeder) (for DFC Prithla south SSP).160 sqmm Jumper specification shall DIN 43138 or Latest RDSO specification.	KM	9,49,190.00	18,000.00	1.2	11,39,028.00	21,600.00	11,60,628.00
4 (b)	Extra on erection under power block @100% on item 4 (a)		0.00	3526.32	1.2	0.00	4,231.59	4,231.59
4 (c)	Extra on Dismantling under power block @100% on Item 4 (c). (Dismantled materials shall be handed over to DFC in store).		0.00	3526.32	1.2	0.00	4,231.59	4,231.59

SUB-SCHEDULE 'B4': NON-FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
5 (a)	Supply and erection of light weight section insulator assembly	Each	1,34,226.00	3130.06	20	26,84,520.00	62,601.20	27,47,121.20
5 (b)	Extra on erection under power block @100% on item 6	Each	0.00	3130.06	12	0.00	37,560.72	37,560.72
6	Supply & Erection of Short Neutral section assembly (PTFE)	Each	6,07,005.76	4839.79	4	24,28,023.04	19,359.16	24,47,382.20
7 (a)	Supply without Insulator and erection of 25 KV single pole motorised isolator without earth contact assembly along with copper busbar	Each	1,17,602.19	2898.53	13	15,28,828.47	37,680.89	15,66,509.36
7 (b)	Extra on erection under power block @100% on item 7 (a)	Each	0.00	2898.53	6	0.00	17,391.18	17,391.18
8(a)	Supply & erection of large copper jumpers including drop jumper for cross feeder copper wire 150/160 sqmm include all clamps and GI nut bolts etc. (2 nos 160 sqmm copper drop jumpers shall come from cross feeder and one no. each shall be connected to catenary and contact wire).160 sqmm Jumper specification shall DIN 43138 or Latest RDSO specification.	Each	5779.49	525.39	62	3,58,328.38	32,574.18	3,90,902.56
8 (b)	Extra on erection under power block @100% on item 8 (a)	Each	0.00	525.40	33	0.00	17,338.20	17,338.20

SUB-SCHEDULE 'B4': NON-FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
9 (a)	Supply & erection of large copper drop jumpers 160 sq.mm between cross feeder and OHE including all clamps and GI bolts etc.(2 nos 160 sqmm copper drop jumpers shall come from cross feeder and one no. each shall be connected to catenary and contact wire).160 sqmm Jumper specification shall DIN 43138 or Latest RDSO specification.	Each	11,063.53	525.39	12	1,32,762.42	6,304.64	1,39,067.05
9 (b)	Extra on erection under power block @100% on item 17		0.00	525.39	12	0.00	6,304.64	6,304.64
9 (c)	Extra on Dismantling under power block @100% on Item 9 (a) (Dismantled materials shall be handed over to DFC office).		0.00	525.39	12	0.00	6,304.64	6,304.64
10	Supply of Earth wire include 19/2.5 mm galvanised steel stranded wire with termination, clamps, adjuster etc. It shall also include connecting by means suitable terminal spades, the end of earth screen wire to the main members of the column of portals, Gantries across which these wires are strung or to 50/6 mm G.I flat earth leads.	KM	99,575.72	2,689.25	0.5	49,787.86	1344.63	51,132.49

SUB-SCHEDULE 'B4': NON-FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
11	Supply without Insulator and erection of a 25 KV single pole isolator without earth contact assembly. (1600 Amp) for switching station.	Nos	41,717.05	2,898.51	10	4,17,170.50	28985.10	4,46,155.60
12	Supply without Insulators & erection of 25kV Double Pole Isolator.	Nos	68,029.85	3,201.28	10	6,80,298.50	32012.80	7,12,311.30
13	Supply & erection of large copper jumpers including for cross feeder copper wire 150 sqmm include all clamps and GI nut bolts etc.150 sqmm Jumper specification shall DIN 43138 or Latest RDSO specification.	Nos	5,779.18	525.38	50	2,88,959.00	26269.00	3,15,228.00
14	Supply & erection of small copper jumpers of 50 sqmm copper include supply of parallel clamp bimetallic strips wherever required and bolted type connector wherever required	Nos	677.46	525.38	72	48,777.12	37827.36	86,604.48
15	Supply of materials and erection of large copper jumper and drop jumper 160 Sq. mm between Aluminium bus and cross feeders	Nos	7,267.76	525.38	12	87,213.12	6304.56	93,517.68
16	Supply and erection of copper strips for equipment earthing.	Metre	624.47	71.24	45	28,101.15	3205.80	31,306.95

SUB-SCHEDULE 'B4': NON-FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
17	Supply & erection of: Aluminium bus-bars 36mm x 28mm.include bending shaping and clamping to insulators, connectors or terminals etc.	Metre	449.40	69.05	400	1,79,760.00	27620.00	2,07,380.00
18	Supply & erection of Solid copper busbars 18mm. Include bending shaping etc.	Metre	2,025.50	97.96	80	1,62,040.00	7836.80	1,69,876.80
19	Supply and erection of Aluminium bus-bar connectors: - Bus terminal (6480) including nut bolts etc at junctions and terminations	Nos	3,090.17	42.36	80	2,47,213.60	3388.80	2,50,602.40
20	Supply and erection of Aluminium bus-bar connectors: - Bus splice (6490) including nut bolts etc at junctions and terminations	Nos	3,414.97	42.35	80	2,73,197.60	3388.00	2,76,585.60
21	Supply and erection of Aluminium bus-bar connectors: - Bus tee connector (6500) including nut bolts etc at junctions and terminations	Nos	3,444.93	37.85	80	2,75,594.40	3028.00	2,78,622.40
22	Supply and erection of Aluminium bus-bar connectors: - Terminal connector 36/20 (6530) including nut bolts etc at junctions and terminations	Nos	3,108.50	37.85	80	2,48,680.00	3028.00	2,51,708.00

SUB-SCHEDULE 'B4': NON-FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
23	Supply and erection of Aluminium bus-bar connectors: - Tap connector (6520) including nut bolts etc at junctions and terminations	Nos	3,108.50	42.30	80	2,48,680.00	3384.00	2,52,064.00
24	Supply and erection of Aluminium bus-bar connectors: - Flexible bus splice (6550) including nut bolts etc at junctions and terminations	Nos	9,042.07	42.30	80	7,23,365.60	3384.00	7,26,749.60
25	Supply and erection of Aluminium bus-bar connectors: - Terminal connector Bolted Type (6830-1) including nut bolts etc at junctions and terminations	Nos	2,458.69	37.85	80	1,96,695.20	3028.00	1,99,723.20
26	Supply & erection of solid copper bus-bar connectors: Bus terminal (6310) including nut bolts etc at junctions and terminations	Nos	2,046.22	42.35	80	1,63,697.60	3388.00	1,67,085.60
27	Supply & erection of solid copper bus-bar connectors: Bus splice (6320) including nut bolts etc at junctions and terminations	Nos	2,258.21	42.35	80	1,80,656.80	3388.00	1,84,044.80
28	Supply & erection of solid copper bus-bar connectors: Bus tee joint (6330) including nut bolts etc at junctions and terminations	Nos	6138.66	42.34	80	4,94,480.00	3387.20	4,94,480.00

SUB-SCHEDULE 'B4': NON-FERROUS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
29	Supply & erection of solid copper bus-bar connectors: Bus terminating tee (6351) including nut bolts etc at junctions and terminations	Nos	4156.96	42.31	80	3,35,941.60	3384.80	3,35,941.60
Total of Sub-Schedule 'B4": Non-Ferrous						1,86,89,084.64	12,90,687.09	1,99,79,771.73

5.3.5 Sub-Schedule 'B5': Catenary and Contact Wire

SUB-SCHEDULE 'B5' CATENARY AND CONTACT WIRE								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
1	Supply 150 sqmm Hard Drawn Grooved Copper Contact Wire	TKM	11,30,172.62	0.00	23.476	2,65,31,932.43	0.00	2,65,31,932.43
2	Supply 120 sqmm, Cadmium copper catenary wire	TKM	9,70,952.47	0.00	21.476	2,08,52,175.25	0.00	2,08,52,175.25
Total of Sub-Schedule 'B5' : Catenary and Contact Wire						4,73,84,107.67	0	4,73,84,107.67

5.3.6 Sub-Schedule 'B6': Insulators

SUB-SCHEDULE 'B6' : INSULATORS								
Item No.	Description	Unit	Material Rate (INR)	Erection Rate (INR)	Qty.	Materials amount (M) in INR	Erection amount (E) in INR	Total Amount in (M+E) in INR
1	2	3	4	5	6	7	8	9 = 7+8
1	Stay Arm Porcelain Insulators	Each	3341.31	0.00	370	12,36,284.70	0.00	12,36,284.70
2	Bracket Porcelain Insulators	Each	2875.71	0.00	370	10,64,012.70	0.00	10,64,012.70
3	9-Ton Porcelain Insulators	Each	4217.35	0.00	667	28,12,972.45	0.00	28,12,972.45
4	Supply of Post & Operating rod insulators	Set	44,233.90	0.00	207	91,56,417.30	0.00	91,56,417.30
5	Supply of 25 kV Post Insulator	Nos	8483.25	0.00	72	6,10,794.00	0.0	6,10,794.00
6	Supply of Post & Operating rod insulators for single pole Isolator	Set	22,116.95	0.00	4	88,467.80	0.0	88,467.80
Total of Sub-Schedule 'B6': Insulators						1,49,68,948.95	0.00	1,49,68,948.95

5.3.7 Sub-Schedule 'B7': SCADA at Harsana Kalan IR SSP

SUB-SCHEDULE 'B7' SCDA AT HARSANA KALAN IR SSP					
Item No.	Description	Unit	Qty.	Unit Rate of Supply & Erection in INR	Total Amount in INR
1	2	3	4	5	6 = 4x5
1	Design and drawings of all work of supply, erection, testing and commissioning of SCADA for the remote-control centre and the controlled station include supply of requisite number of copies of designs, drawings, operating, maintenance and troubleshooting manuals, technical booklets, and completion drawings.	Lumpsum	1	1,97,332.55	1,97,333.55
2	Supply, erection, testing and commissioning of Remote station equipment (RTU) at remote station for Sub-sectioning Post (SSP) including power supply units, separate earthing, interconnecting cables, wiring etc. and all materials necessary for proper functioning of RTU including testing of materials and equipment at manufacturer's works. This will also include necessary transducers, summation CT, PT, supply change over arrangement, digital analogue modules, limit settings, CPU cards, surge arrester, relays, and contactors etc.	Nos	1	9,08,444.86	9,08,445.86
3	Modification/upgradation, testing and commissioning in existing standard SCADA software at RCC equipment for configuration, integration/hooks up of additional RTU with master station equipment/RCC.	Nos	1	7,83,369.45	7,83,369.45
Total of Sub-Schedule 'B7' : SCADA at Harsana Kalan IR SSP					18,89,146.86

5.3.8 Sub-Schedule 'B8': Non-Schedule (NS) Items

SUB-SCHEDULE 'B8' NON-SCHEDULE (NS) ITEMS					
Item No.	Description	Unit	Qty.	Unit Rate of Supply & Erection in INR	Total Amount in INR
1	2	3	4	5	6 = 4x5
1	Supply and erection of OHE caution board with supply of fixing material (Clamp, back flat strip & fastener) for "caution clearance to OHE nearby rectified" Board Size 400mmx270mmx2mm	Nos.	60	758.27	45,496.20
2	Fabrication, developing and supply of sectioning diagram, schematic and TSWR board developing the sectioning diagram, schematic diagram & TSWR diagram with computerised digital printing on adhesive vinyl of adequate size as required.	Square foot	500	548.39	2,74,192.50
3	Setting up of earthing Station with buried rail at Switching post include supply of 75x8 mm GI flat for connection between buried rail and earth electrode and for connection between buried rail and running rail including nuts, bolts, copper rivets, spring washers, drilling of holes in flat /rail along with excavation and compaction of buried rail pit.	Job	3	65,313.00	1,95,939.00
4	Supply & Erection of Safety item with supply of fixing material (Plastic/wooden/gritty & Screw) for supply & erection of electric shock treatment chart (Glass framed) size 22"x28" complete with aluminium angle beading 1"x1" all around	Nos.	12	736.02	8,832.24
5	Provision of First Aid box and stretcher with wooden box and hanging arrangement etc.	Nos.	4	11,869.00	47,476.00
6	Provision of Wooden key box with glass front in frame with hinges and locking arrangement 18x24x6 inch.	Nos.	3	2,701.00	8,103.00
7	Supply of hand Gloves (Tested for 25 kV AC)	Nos.	6	1,155.00	6,930.00

SUB-SCHEDULE 'B8' NON-SCHEDULE (NS) ITEMS					
Item No.	Description	Unit	Qty.	Unit Rate of Supply & Erection in INR	Total Amount in INR
1	2	3	4	5	6 = 4x5
8	Provision of Portable firefighting Dry Chemical powder 5 Kg ISI mark	Nos.	3	3,270.00	9,810.00
9	Provision of Portable firefighting- CO2 fire extinguisher 10 Kg	Nos.	3	14,527.00	43,581.00
10	Provision of Portable firefighting- Fire bucket 10 Litres	Nos.	8	320.00	2,560.00
11	Provision of Portable firefighting- Fire bucket Stand	Nos.	4	2,139.00	8,556.00
12	Supply & Erection of Electric Shock treatment chart & its first aid coloured calendar in Hindi & English Size-550mm x 900mm with plastic at top & bottom	Nos.	6	58.00	348.00
13	Supply of AC and DC distribution board.	Nos.	3	41,787.07	1,25,361.21
14	Erection of AC and DC distribution board.	Nos.	3	886.83	2,660.49
15	(1) Hiring of AC vehicles Innova Crysta on monthly basis for the use of GC/HRIDC officials at Manesar/Gurugram for 2500 km per month. The rates are inclusive of all duties, GST, royalties, cost of maintenance, major/minor repairs, cost of lubricants, fuel, drivers, and other taxes etc for the complete job. Toll tax and parking charges shall be paid extra on certification of official using vehicle. Vehicles shall not be more than one year old.	vehicle month	96	69,345.00	66,57,120.00
	(2) Extra charge beyond 2500 km per month per vehicle (96x500=48000)	km	48000	13.09	6,28,320.00

SUB-SCHEDULE 'B8' NON-SCHEDULE (NS) ITEMS					
Item No.	Description	Unit	Qty.	Unit Rate of Supply & Erection in INR	Total Amount in INR
1	2	3	4	5	6 = 4x5
16	(1) Hiring of AC vehicles Bolero / Ertiga (SUV) on monthly basis for the use of GC/HRIDC officials at Manesar/Gurugram for 2500 km per month. The rates are inclusive of all duties, GST, royalties, cost of maintenance, major/minor repairs, cost of lubricants, fuel, drivers, and other taxes etc for the complete job. Toll tax and parking charges shall be paid extra on certification of official using vehicle. Vehicles shall not be more than one year old.	vehicle month	96	51,670.91	49,60,407.36
	(2) Extra charge beyond 2500 km per month per vehicle (96x500=48000)	km	48000	13.09	6,28,320.00
Sub-Schedule 'B8': Non-Schedule (NS) Items:					1,36,54,013.00
Grand Total of Schedule 'B': (B1+ B2+B3+B4+B5+B6+B7+B8)					24,22,19,183.59

Total Estimated amount for Schedule 'B': INR 24,22,19,183.59

Price Schedule

(Please refer Price Schedule uploaded on eProcurement portal)

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Tender Inviting Authority: Haryana Rail Infrastructure Development Corporation Limited

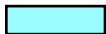
Name of Work: Contract Package SYS-1: Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km 125.98 to Km 125.98 including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC network at Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 1.500 TKM)

Contract No: HORC/HRIDC/CSYS-1/2023

Name of the Bidder/
Bidding Firm
/ Company :

PRICE SCHEDULE: Schedule A
(This BOQ template must not be modified/replaced by the bidder and the same should be uploaded in relevant columns, else the bidder is liable to be rejected for this tender. Bidders are allowed to enter only numerical values only)

NUMBER #	TEXT #	TEXT #	UNIT	RATE IN	TOTAL AMOUNT With	TOTAL AMOUNT
Sl. No.	Item Description	Unit	Rs. P	Rs. P	Taxes	In Words
1.01	Schedule A: Lumpsum component of Work	Lump Sum			0.00	INR Zero Only
Total in Figures					0.00	INR Zero Only
Quoted Rate in Words						INR Zero Only



**Tenderer is only required to fill the information in the boxes highlighted with cyan colour in Price Schedule (Excel sheet)*

Price Schedule

(Please refer Price Schedule uploaded on eProcurement portal)

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Tender Inviting Authority: Haryana Rail Infrastructure Development Corporation Limited

Name of Work: Contract Package SYS-1: Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km (-)2.099 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 315 TKM)

Contract No: HORC/HRIDC/SYS-1/2023

Name of the Bidder/
Bidding Firm
/ Company :

PRICE SCHEDULE: Schedule 'B'

(This BOQ template must not be modified/replaced by the bidder and the same should be uploaded after filling the relevent columns, else the bidder is liable to be rejected for this tender. Bidders are allowed to enter the Bidder Name and Values only)

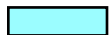
NUMBER #	TEXT #	NUMBER	NUMBER #	TEXT	NUMBER #	TEXT #
Sl. No.	Item Description	Estimated Rate in Rs. P	PERCENTAGE RATE (%) to be entered by the Bidder	Select Excess or less	TOTAL AMOUNT With Taxes Rs. P	TOTAL AMOUNT In Words
1	Schedule 'B': OHE works for IR Connectivity and feeder (Harsana Kalan IR SSP to New Harsana Kalan OHE)					
1.01	Sub-Schedule B1: General	6,22,05,356.72		SELECT		INR Zero Only
1.02	Sub-Schedule B2: Concrete	2,17,55,696.79		SELECT	0.00	INR Zero Only
1.03	Sub-Schedule B3: Ferrous	6,03,82,141.87		SELECT	0.00	INR Zero Only
1.04	Sub-Schedule B4: Non Ferrous	1,99,79,771.73		SELECT	0.00	INR Zero Only
1.05	Sub-Schedule B5: Catenary and Contact Wire	4,73,84,141.87		SELECT	0.00	INR Zero Only
1.06	Sub-Schedule B6: Insulators			SELECT	0.00	INR Zero Only
1.07	Sub-Schedule B7: SCADA at Harsana Kalan	1,36,54,013.00		SELECT	0.00	INR Zero Only
1.08	Sub-Schedule B8: Non-Schedule	1,36,54,013.00		SELECT	0.00	INR Zero Only
Total in Figures					0.00	INR Zero Only
Quoted Rate in Word					INR Zero Only	

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Price Schedule

(Please refer Price Schedule uploaded on eProcurement portal)

PRICE SCHEDULE-SUMMARY SHEET			
(This BOQ template must not be modified/replaced by the bidder and the same should be uploaded after filling the relevant details else the bidder is liable to be rejected for this tender. Bidders are allowed to enter the Bidder Name and Values)			
NUMBER #	TEXT #	NUMBER #	TEXT #
Sl. No.	Item Description	TOTAL AMOUNT With Taxes Rs. P Rs. P	TOTAL In Words
1.01	Schedule A: Lumpsum component of Works	0.00	INR Zero Only
1.02	Schedule B: OHE works for IR Connectivity and feeder (Harsan Kalan IR SSP to New Harsana Kalan OHE)	0.00	INR Zero Only
1.03	Provisional Sum	10,00,00,000.00	INR Ten Crore Only
Total in Figures		10,00,00,000.00	INR Ten Crore Only
Quoted Rate in Words		INR Ten Crore Only	



**Tenderer is only required to fill the information in the boxes highlighted with cyan colour in Price Schedule (Excel sheet)*