Bid Document for Works

(Two-Envelope Bidding Process Without Prequalification)

Procurement of:

Design, Supply, Installation, Testing & Commissioning of Signalling & Telecommunication system in connection with yard remodelling at Patli station (Existing N. Rly. station in Delhi-Rewari section) for Haryana Orbital Rail Corridor (HORC) project

Bid No: HORC/HRIDC/Patli/S&T/2023
Contract title: Patli S&T Tender **(Design & Build on BoQ basis)**
Project: Haryana Orbital Rail Corridor Project
Employer: Haryana Orbital Rail Corporation Limited
Country: INDIA
Issued on: 21.04.2023

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Invitation For Bids (IFB)

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PART I

Bidding Procedure

Section 1

Instructions to Bidders (ITB)

Section 1: Instructions to Bidders (ITB)

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Section 1: Instructions to Bidders (ITB)

A. General

1. Scope of Bid

1.1 In connection with the Invitation for Bids indicated in the Bid Data Sheet (BDS), Haryana Orbital Rail Corporation Limited (HORCL), hereinafter referred to as the 'Employer', issues these Bidding Documents for the Procurement of Works as specified in Section 5: Works Requirements. The name, identification, number of contract(s) for the National Competitive Bidding (NCB) are provided in the BDS.

1.2 Throughout these Bidding Documents:

(a) the term "in writing" means communicated in written form and delivered against receipt;

(b) except where the context requires otherwise, words indicating the singular also include the plural and words indicating the plural also include the singular; and

(c) "day" means calendar day.

2. Source of Funds

2.1 The required funds have been sourced by EMPLOYER, unless otherwise specified in the BDS.

3. Corrupt Practices

3.1 The Employer requires that bidders, suppliers, and contractors observe the highest standard of ethics during the procurement and execution of such contracts. In pursuance of this policy, the Employer:

(a) defines, for the purposes of this provision, the terms set forth below as follows:

(i) "corrupt practice" means the offering, giving, receiving, or soliciting, directly or indirectly, of any thing of value to influence the action of any party in the procurement process or the execution of a contract;

(ii) "fraudulent practice" means a misrepresentation or omission of facts in order to influence a procurement process or the execution of a contract;

(iii) "collusive practice" means a scheme or arrangement between two or more bidders, with or without the knowledge of the Employer, designed to influence the action of any party in a procurement process or the execution of a contract;

(iv) "coercive practice" means harming or threatening to harm, directly or indirectly, persons, or their property to influence their participation in a procurement process, or affect the execution of a contract;

(b) will reject a Bid for award if it determines that the bidder recommended for award has, directly or through an agent, engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract; and

(c) will sanction a party or its successor, including declaring ineligible, either indefinitely or for a stated period of time, to participate in Employer's activities, if it at any time determines that the firm has, directly or through an agent, engaged in

corrupt, fraudulent, collusive, or coercive practices in competing for, or in executing a contract of the employer.

4. Eligible **Bidders**

4.1 A Bidder may be a natural person, private entity, government-owned entity, or any combination of them with a formal intent to enter into an agreement or under an existing agreement in the form of a Joint Venture (JV). The bidder must ensure the following:

(a) In case of Single Entity:

(i) Submit Power of Attorney authorizing the signatory of the bid to commit the bidder.

(b) In case of Joint Venture:

(i) The number of partners in the JV shall not be more than that indicated in the Bid Data Sheet (BDS);

(ii) Submit MOU, as per form given in Section 4.

(iii) The JV shall nominate a Representative through Power of Attorney (Form given in Section 4) who shall have the authority to conduct all business for and on behalf of any and all the parties of the JV during the bidding process and, in the event the JV is awarded the Contract, during contract execution.

(iv) Submit Power of Attorney by individual partners to lead partners as per form given in Section 4.

(v) In case a Joint Venture is the successful bidder, the Joint Venture Agreement should be entered by the Joint Venture partners. The duly signed Joint Venture Agreement should be submitted along with the Performance Security to the employer after notification of the award of contract within 28 days.

(c) Foreign Firm(s) shall only be eligible to participate either as a single entity or as a partner in JV, if they have already opened project office in India and have to submit proof of the same along with the bid, failing which the bid shall be rejected.

(d) Any bidder from a country which shares a land border with India will be eligible to bid, only if the bidder is registered with the Competent Authority as stated in DoE Order no 6/18/2019-PP dtd 23 July 2020 (Public Procurement No.1). However, it will not apply to bidders from those countries (even if sharing land border with India) to which the Government of India has extended lines of credit or in which the Government of India is engaged in development projects as stated in DoE Order no 6/18/2019-PP dtd 23 July 2020 (Public Procurement No.2) or any amendments thereof.

1) "Bidder from a country which shares a land border with India" means:

i. An entity incorporated, established or registered in such a country; or

ii. A subsidiary of an entity incorporated, established or registered in such a country; or

iii. An entity substantially controlled through entities incorporated, established or registered in such a country; or

iv. An entity whose beneficial owner is situated in such a country; or

v. An Indian (or other) agent of such an entity; or

vi. A natural person who is a citizen of such a country; or

vii. A consortium or joint venture where any member of the consortium or joint venture falls under any of the above

2) The *beneficial owner* for the purpose of 1) above will be as under:

i. In case of a company or Limited Liability Partnership, the beneficial owner is the natural person(s), who, whether acting alone or together or through one or more juridical person, has a controlling ownership interest or who exercises control through other means.

Explanation—

a. "Controlling ownership interest" means ownership of or entitlement to more than twenty-five percent of shares or capital or profits of the company.
b. "Control" shall include the right to appoint majority of the directors or to control the management or policy decision including by virtue of their shareholding or management rights or shareholders agreements or voting agreements.

ii. In case of partnership firm, the beneficial owner is the natural person(s) who, whether acting alone or together or through one or more juridical person, has ownership or entitlement to more than fifteen percent of capital or profits of the partnership;

iii. In case of an unincorporated association or body of individuals, the beneficial owner is the natural person(s), who, whether acting alone or together or through one or more juridical person, has ownership of for entitlement to more than fifteen percent of the property or capital or profits of such association or body of individuals;

iv. Where no natural person is identified under (i) or (ii) or (iii) above, the beneficial owner is the relevant natural person who holds the position of senior managing official;

v. In case of a trust, the identification of beneficial owner(s) shall include identification of the author of the trust, the trustee, the beneficiaries with fifteen percent or more interest in the trust and any other natural person exercising ultimate effective control over the trust through a chain of control or ownership.

(e) Eligible bidder can be either 'Class-I Local' or 'both Class-I Local and Class-II Local' or 'combination of Class-I Local, Class-II Local and Non-local', as defined below.

i. Class-I Local- means a supplier or service provider, whose goods, services or works offered for procurement meets the minimum local content of 50%.

ii. Class-II Local- means a supplier or service provider, whose goods, services or works offered for procurement meets the minimum local content of 20%.

iii. Non-local- means a supplier or service provider, who does not meet the requirements as per i and ii above.

The Bidders are required to submit a declaration using 'Form-MII' of Section 4 Bidding Forms.

In keeping with the Public Procurement (Preference to Make in India) Order 2017, as amended from time-to-time up to 28 days prior to deadline for submission of bids, in case any bidder, who does not meet the eligibility criteria as prescribed vide clause 4.1 above, shall participate at its own risk & cost and Employer shall not be liable for any loss or damage caused to the bidder.

4.2 Deleted.

4.3 A Bidder shall not have conflict of interest. All Bidders found to have a conflict of interest shall be disqualified. A Bidder may be considered to be in a conflict of interest with one or more parties in this bidding process, if, including but not limited to:

(a) they have controlling shareholders in common; or

(b) they receive or have received any direct or indirect subsidy from any of them; or

(c) they have the same legal representative for purposes of this bid; or

(d) they have a relationship with each other, directly or through common third parties, that puts them in a position to have access to information about or influence on the Bid of another Bidder, or

(e) a Bidder participates in more than one bid in this bidding process. Participation by a Bidder in more than one Bid will result in the disqualification of all Bids in which the party is involved. However, this does not limit the inclusion of the same subcontractor in more than one bid; or

(f) a Bidder participated as a consultant in the preparation of the design or technical specifications of the contract that is the subject of the Bid; or

(g) a Bidder was affiliated for any period(s)during last two years before the date of issue of Invitation for Bids with a firm or entity that has been hired (or is proposed to be hired) by the Employer as Engineer for the contract.

4.4 The bidder will be disqualified if:

a. The bidder or any of its constituents has been blacklisted/ banned business dealings for all Government Departments or by Ministry of Railways or by EMPLOYER at any time till finalization of bids, except in cases where such blacklisting/ banning has been withdrawn by Competent Authority or has ceased on the deadline for submission of the bids, for which satisfactory evidence is to be produced.

b. Any previous contract of the bidder or any of its constituents had been terminated for contractor's failure or part terminated for its failure as a JV partner with forfeiture of its full Performance Security, by Haryana Orbital Rail Corporation Limited.(HORCL) at any time

starting from 3 years before the deadline for submission of bids and upto one day before the date of opening of price bids;

Provided, however, there is no stay order or declaration by any Court against such termination of the Contract by Haryana Orbital Rail Corporation Limited. or such termination of the Contract has not been revoked by Haryana Orbital Rail Corporation Limited or competent authority of EMPLOYER has not passed an order of non-applicability of disqualification of the bidder or any of its constituents despite such termination.

c. The bidder or any of its constituents has been imposed delay damages of 5% or more of contract value by EMPLOYER due to delay in the implementation of any previous contract within the period of last 2 years before the deadline for submission of bids (Period of 2 years shall be reckoned from the date on which the total accrued amount of Delay Damages has reached 5% or more of the contract price) or such accrued delay damages has not been fully recovered before the deadline for submission of bids on account of contractor's request for deferring recovery to maintain cash flow and EMPLOYER has acceded to the same in the interest of the project or the work under the previous contract in question has not been completed before the deadline for submission of bids, unless imposition of such delay damages has been set aside by the Competent Authority.

d. The bidder or any of its constituents:

i. has suffered bankruptcy/insolvency or

ii. has any ongoing case of insolvency before the NCLT/any Court where Interim Resolution Professional (IRP) has been appointed or is at any later stage of the insolvency process

On the deadline of submission of bids or thereafter till finalization of bids.

e. The bidder is found ineligible by the Employer, in accordance with ITB-3.

f. The bidder or its constituent(s) has been declared by EMPLOYER to be a poor performer and the period of poor performance is still in force on the deadline for submission of bids.

OR

The bidder or its constituent(s) has been declared by EMPLOYER to be a poor performer at any time after the deadline for submission of bids and upto one day before the date of opening of price bids.

g. The bidder or any of its constituents has changed its name or created a new business entity as covered by the definition of "Allied Firm" under para 1102 (iii) of Chapter XI of Vigilance Manual of Indian Railways (available on website of Indian Railways), consequent to having been banned business dealings or suspended business dealings or having been declared poor performer.

h. The bidder or any of its constituents is from a country which shares a land border with India and is not registered with the Competent Authority as stated in DoE Order no 6/18/2019-PP dtd 23 July 2020 .

i. Bidder is an Entity of such countries, which have been identified by the Railway Ministry as not allowing Indian Companies to participate in their Government procurements for any item related to Railway Ministry, shall not be allowed to participate, except for the list of items published by the Railway Ministry permitting their participation.

j. Bidder fails to disclose any previous transgressions made in respect of Code of Integrity [Rule 175 (1) of General Financial Rules 2017] with any entity in any country during the last three years or of being debarred by any other procuring entity

The Bidder shall submit an affidavit stating that they are not liable to be disqualified as per this sub clause using the appropriate Performa given in Section 4. Non-submission of an affidavit by the bidder shall result in summary rejection of his bid.

4.5 Bidders shall immediately inform the Employer in case they cease to fulfill eligibility in terms of ITB 4.3 & 4.4. In case the bidder fails to inform the Employer or submits a false affidavit his bid shall be summarily rejected and bid security shall be forfeited. The bidder shall also be liable for Banning of Business dealings for a period up to five years. .

5. Eligible Materials, Equipment and Services

5.1 The materials, equipment and services to be supplied under the Contract shall be from the approved sources as specified in Section 5: Works Requirements.

B. Contents of Bidding Document

6. Sections of Bidding Document

6.1 The Bidding Document consists of Volume-I (Parts I, II and III) and Volume-II, which includes all the Sections indicated below, and should be read in conjunction with any Addenda issued in accordance with ITB 8.

Volume-I

PART I: Bidding Procedures

Section 1: Instructions to Bidders (ITB)

Section 2: Bid Data Sheet (BDS)

Section 3: Evaluation and Qualification Criteria (EQC)

Section 4: Bidding Forms (BDF)

PART II: Work's Requirements

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PART III: Conditions of Contract and Contract Forms

Section 6: General Conditions of Contract (GCC)

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Volume-II

Bill of Quantities(BOQ)

6.2 The Invitation for Bids (IFB) issued by the Employer is not part of the Bidding Document.

6.3 The Employer is not responsible for the completeness of the Bidding Document and their Addenda, if they were not obtained directly from the source stated by the Employer in the Invitation for Bids.

6.4 The Bidder is expected to examine all instructions, forms, terms, and specifications in the Bidding Document. Failure to furnish all information or documentation required by the Bidding Document may result in the rejection of **the** bid.

7. Clarification of Bidding Document, Site Visit, Pre-Bid Meeting

7.1 A prospective Bidder requiring any clarification of the Bidding Document shall contact the Employer in writing at the Employer's address indicated in the BDS or raise his inquiries during the pre-bid meeting if provided for in accordance with ITB 7.4. The Employer will respond in writing to any request for clarification, provided that such request is received no later than twenty one (21) days prior to the deadline for submission of bids. The Employer shall forward copies of its response to all Bidders who have acquired the Bidding Document in accordance with ITB 6.3, including a description of the inquiry but without identifying its source. Should the Employer deem it necessary to amend the Bidding Document as a result of a request for clarification, it shall do so following the procedure under ITB 8 and ITB 22.2.

7.2 The Bidder 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 bid and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the Bidder's own expense.

7.3 The Bidder 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 Bidder, 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 The Bidder's designated representative is invited to attend a pre-bid meeting, if provided for in the BDS either in person or through video conferencing. 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 Bidder is requested, as far as possible, to submit any questions in writing, to reach the Employer not later than one week before the meeting.

7.6 Minutes of the pre-bid 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 transmitted promptly to all Bidders who have acquired the Bidding Document in accordance with ITB 6.3. Any modification to the Bidding Document that may become necessary as a result of the pre-bid meeting shall be made by the Employer exclusively through the issue of an addendum pursuant to ITB 8 and not through the minutes of the pre-bid meeting.

7.7 Non-attendance at the pre-bid meeting will not be a cause for disqualification of a Bidder.

8. Amendment of Bidding Document

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

8.2 Any addendum/corrigendum issued shall be part of the Bidding Document.

8.3 To give prospective Bidders reasonable time in which to take an addendum into account in preparing their bids, the Employer may, at its discretion, extend the deadline for the submission of bids, pursuant to ITB 22.2

C. Preparation of Bids

9. Cost of Bidding

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

10. Language of Bid

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

11. Documents Comprising the Bid

11.1 The bidder shall submit both technical and financial bids through e tendering portal only.

11.2 Initially, only the Technical Bids are opened through e tendering portal. The Technical Bids are evaluated by the Employer. No amendments or changes to the Technical Bids are permitted. Bids with Technical Bids which do not conform to the specified requirements will be rejected as deficient Bids.

11.3 Price Bids of technically compliant Bids shall be opened through e tendering portal of EMPLOYER at a date and time advised by the Employer. The Price Bids are evaluated and the Contract is awarded to the Bidder whose Bid has been determined to be the lowest evaluated substantially responsive Bid.

11.4 The Technical Bid shall contain the following :

(a) Scanned copy of Letter of Technical Bid in accordance with ITB 16;

(b) Scanned copy of Bid Security, in accordance with ITB Clause 19;

(c) Scanned copy of alternative Technical Bid, if permissible, in accordance with ITB Clause 13;

(d) Scanned copy of written confirmation authorizing the signatory of the Bid to commit the Bidder, in accordance with ITB Clause 20.2;

(e) Scanned copy of documentary evidence in accordance with ITB Clause 17 establishing the Bidder's qualifications to perform the contract; and

(f) Scanned copy of any other document required in the BDS.

11.5 The Price Bid shall contain the following :

(a) Scanned copy of Letter of Price Bid. ;

(b) Summary sheet completed online as per ITB 14

(c) Online alternative Price Bid corresponding to the alternative Technical Bid, if permissible, in accordance with ITB Clause 13; and

(d) any other document required in the BDS.

12. Bid Letters and Price Schedules

12.1 The Bidder shall submit the Technical Bid and the Price Bid online through e tendering portal using appropriate letter formats furnished in Section 4: Bidding Forms. These forms must be completed without any alterations to their format, and no substitutes shall be accepted. All blank spaces shall be filled in with the information requested.

12.2 The Bidder shall submit, as part of the Price Bid, including the Bill of Quantities through online e –Tendering portal.

13. Alternative Bids

13.1 Unless otherwise indicated in the BDS, alternative bids shall not be considered.

13.2 When alternative periods for completion are explicitly invited, a statement to that effect will be included in the BDS, as will the method of evaluating different periods for completion.

14. Bid Prices and Discounts

14.1 The prices quoted by the Bidder online in the summary sheet of Bill of Quantities shall conform to the requirements specified below.

14.2 In the BOQ, quantity and unit rates and thereby the amount against each item have been indicated. From this, price of each schedule/bill has been worked out and indicated in the summary sheet in BOQ. The Bidder shall quote rates as single percentage above/below/at par in figures as per format for each schedule/bill in the summary sheet**. The rates quoted by the bidder in summary sheet will only be considered for evaluation of bids. Rates offered through any other medium or at any other location will not be considered.**

14.3 Deleted

14.4 The Bidder can modify its bid and resubmit it any number of times through e Tendering portal before the deadline for submission of bids. Any other correspondence in connection with the bid is not permissible and shall not be considered in bid evaluation.

14.5 Unless otherwise provided in the BDS and the Contract, the rates and prices quoted by the Bidder 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 indices and weightings for the price adjustment formulae shall be as specified in the Tables of Adjustment Data included in Contract Data.

14.6 If so indicated in ITB 1.1, bids are being invited for individual contracts or for any combination of contracts (packages). Bidders wishing to offer any price reduction for the award of more than one Contract shall specify in their bid the price reductions applicable to each package, or alternatively, to individual Contracts within the package. Price reductions or discounts shall be submitted in accordance with ITB 14.4, provided the bids for all contracts are submitted and opened at the same time.

14.7 All duties, taxes, and other levies payable by the Contractor under the Contract, or for any other cause (including standard specifications), as of the date 28 days prior to the deadline for submission of bids, shall be included in the rates and prices and the total Bid Price submitted by the Bidder.

14.8 Bidders should note that during the progress of the Works, the foreign currency requirements of the outstanding balance of the Contract Price may be adjusted by agreement between the Employer and the Contractor in order to reflect any changes in foreign currency requirements for the Contract, in accordance with Sub-Clause 14.15 of the Conditions of Contract. Any such adjustment shall be effected by comparing the percentages quoted in the bid with the amounts already used in the Works and the Contractor's future needs for imported items.

14.9 Bidder should note that non-submission of the Letter of Price Bid (LPB) and/or Summary sheet of BOQ by the bidder shall result in summary rejection of his bid.

15. Currencies of Bid and Payment

15.1 The bidder shall quote the unit rates and the prices entirely in the Indian Rupees.

16. Documents Comprising the Technical Bid

16.1 The Bidder shall furnish a commitment inLetter of Technical Bid(LTB)for deployment of equipment and personnel as stipulated in Section 5: Work's Requirement

16.2 The bidder shall furnish commitment inLTB for submitting construction method statement for all major activities of work and get this approved from the engineer prior to the commencement of work on that activity in case of award of contract.

16.3 The Bidder shall furnisha commitment in Letter of Technical Bid(LTB)for adhering to mobilisation and construction schedule as stipulated in Section 5: Work's Requirement.

16.4 Bidder should note that non-submission of the Letter of Technical Bid (LTB) by the bidder shall result in summary rejection of his bid.

17. Documents Establishing the Qualifications of the Bidder

17.1 To establish its qualifications to perform the Contract in accordance with Section 3: Evaluation and Qualification Criteria, the Bidder shall submit as part of its technical Bid the information requested in the corresponding information sheets included in Section 4: Bidding Forms.

17.2 Domestic Bidders, individually or in joint ventures, applying for eligibility for domestic preference shall supply all information required to satisfy the criteria for eligibility as described in ITB 34.

18. Period of Validity of Bids

18.1 Bids shall remain valid for a period of 120 days after the bid submission deadline date prescribed by the employer. A bid valid for a shorter period shall be rejected by the employer as non responsive.

18.2 In exceptional circumstances, the Employer may request Bidders to extend the period of validity of their bids. The request and the responses shall be made in writing. If a bid security is requested in accordance with ITB 19, it shall also be extended upto the date mentioned in the letter of request for extension. A Bidder may refuse the request without forfeiting its bid security. A Bidder granting the request shall not be required or permitted to modify its bid.

19. Bid Security/ Bid Security Declaration

19.1 Unless otherwise specified in the BDS, the Bidder shall furnish as part of its bid, in original form, either a Bid Security Declaration or a bid security in original form and for the said amount of Indian Rupees as specified in the BDS.

19.2 If a Bid Security Declaration is required pursuant to ITB 19.1, it shall use the form included in Section 4 (Bidding Forms). The Employer will declare a Bidder ineligible to be awarded a contract for a period of 3 (three) years , if a Bid Security Declaration is executed

19.3 If a Bid Security is specified pursuant to ITB 19.1, the bid security shall be, at the Bidder's option, in any of the following forms:

(a) A Cashiers or Banker's certified cheque or Bank draft drawn on a Scheduled/Nationalized Bank in India in favour of "Haryana Orbital Rail Corporation Limited" payable at Gurugram; or

(b) An unconditional bank guarantee using the Form given in Section 4: Bidding Forms. The bank guarantee shall be from a bank having minimum net worth of over INR 500 million from the specified banks as under:

(i) **a Scheduled Bank in India, or**

(ii) **a Foreign Bank having their operations in India, or**

(iii) **a Foreign Bank which do not have operations in India is required to provide a counter-guarantee by State Bank of India,**

The bid security shall be valid upto the date as mentioned in BDS, or upto the date mentioned in the letter of request for extension, if any under ITB 18.2.

In case the bidder has opted for Bid security in the form of an unconditional Bank guarantee, the bidder should upload the scanned copy of Bank Guarantee with the bid. The original Bank Guarantee should be delivered in person to the official nominated as indicated in the bid data sheet within 5 working days of deadline of submission of bids. Non submission of scanned copy of Bank Guarantee with the bid on e-tendering portal and/or non submission of original Bank Guarantee within the specified period shall lead to summary rejection of bid. The details of the BG, physically submitted should match with the details available in the scanned copy and the data entered during bid submission time, failing which the bid will be rejected.

19.4 Any bid not accompanied by an enforceable and compliant bid security or Bid Security Declaration, as required in accordance with ITB 19.1, shall be summarily rejected by the Employer as non-responsive.

19.5 The bid security of the Bidders who have been determined to be unqualified for opening of their financial bids shall be returned within 3 working days after the opening of financial bids. The Bid Security of unsuccessful bidders shall be returned within 3 working days after issue of LOA to the successful Bidder.

19.6 The bid security of the successful Bidder shall be returned as promptly as possible once the successful Bidder has signed the Contract and furnished the required performance security.

19.7 The bid security may be forfeited or the Bid Security Declaration executed;

(a) if a Bidder withdraws its bid during the period of bid validity specified by the Bidder on the Letter of Bids, except as provided in ITB 18.2 or

(b) if a Bidder misrepresents or omits the facts in order to influence the procurement process;

(c) if the successful Bidder fails to:

(i) sign the Contract in accordance with ITB 40;

(ii) furnish a performance security in accordance with ITB 41;

(iii) accept the correction of its Bid Price pursuant to ITB 32.2; or

(iv) furnish a domestic preference security if so required.

(d) if the undertaking of the affidavit submitted by the bidder or its constituents in pursuance to ITB clause 4.4 or any of the declarations of Letter of Technical Bid or Letter of Price Bid submitted by the bidder has been found to be false at any stage during the process of bid evaluation.

19.8 The Bid Security of a JV shall be in the name of the JV that submits the bid. If the JV has not been legally constituted at the time of bidding, the Bid Security shall be in the names of all future partners as named in the letter of intent mentioned in ITB 4.1.

20. Format and Signing of Bid

20.1 The Bidder shall submit Technical Bid and the Price Bid as described in ITB Clause 11 through e tendering portal of Govt. of Haryana (https://etenders.hry.nic.in).

20.2 The Bid shall be digitally signed by a person dully authorized to sign on behalf of thebidder.

20.3 DELETED

D. Submission and Opening of Bids

21. Online submission and opening of bids

21.1 The Bidder shall submit the Technical and price bid through e tendering portal of Govt. of Haryana (https://etenders.hry.nic.in)

21.2 DELETED

21.3 DELETED

21.4 DELETED.

21.5 DELETED

21.6 No details about price proposal shall be disclosed directly or indirectly in the technical proposal failing which the bid shall be rejected.

22. Deadline for Submission of Bids

22.1 Bids must be received by the Employer through e tendering portal Govt. of Haryana (https://etenders.hry.nic.in) only not later than the date and time indicated in the BDS.

22.2 The Employer may, at its discretion, extend the deadline for the submission of bids by amending the Bidding Document in accordance with ITB 8, in which case all rights and obligations of the Employer and Bidders previously subject to the deadline shall thereafter be subject to the deadline as extended.

23. Late Bids

23.1 The e-Tendering portal cannot accept any bid once the deadline for the Bid submission has lapsed.

24. Withdrawal, Substitution, and Modification of Bids

24.1 A Bidder may withdraw, or modify its bid after it has been submitted through e-Tendering portal before the deadline for submission of bids..

(a) DELETED

(b) DELETED

24.2 DELETED.

24.3 No bid may be withdrawn, or modified in the interval between the deadline for submission of bids and the expiration of the period of bid validity specified by the Bidder on the Letter of Bid or any extension thereof.

25. Bid Opening

25.1 The Employer shall conduct the opening of Technical Bids through e-tendering portal of Govt. of Haryana (https://etenders.hry.nic.in).

25.2 The Price Bids will remain unopened until the time of opening of the Price Bids. The date, and time, of the opening of Price Bids will be announced through e- tendering portal.

25.3 DELETED

25.4 DELETED

25.5 DELETED

25.6 DELETED

25.7 DELETED

25.8 At the end of the evaluation of the Technical Bids, the Employer will intimate bidders who have submitted substantially responsive Technical Bids and who have been determined as being qualified for award. The date and time of the opening of Price Bids will be advised through email.

25.9 The Employer will notify Bidders in writing who have been rejected on the grounds of being substantially non-responsive to the requirements of the Bidding Document and who have been determined as being not qualified as a result of evaluation of Technical Bid and their Price Bids shall not be opened. The bid security of the bidders shall be returned as per due process.

25.10 The Employer shall conduct the opening of Price Bids through e tendering portal of Govt. of Haryana (https://etenders.hry.nic.in)of all Bidders who submitted substantially responsive Technical Bids and who have been determined qualified as a result of technical evaluation.

25.11 DELETED

25.12 DELETED

E. Evaluation and Comparison of Bids

26. Confidentiality

26.1 Information relating to the examination, evaluation & comparison, pre-qualification of Bids and recommendation of contract award, shall not be disclosed to Bidders or any other persons not officially concerned with such process until information on Contract award is communicated to all Bidders.

26.2 Any attempt by a Bidder to influence the Employer in the examination, evaluation & comparison and pre-qualification of the

Bids or Contract award decisions may result in the rejection of its Bid.

26.3 Notwithstanding ITB Sub-Clause 26.2, from the time of opening the Technical Bids to the time of Contract award, if any Bidder wishes to contact the Employer on any matter related to the bidding process, it should do so in writing.

27. Clarification of Bids

27.1 To assist in the examination, evaluation & comparison and pre-qualification of the Bids, the Employer may, at its discretion, ask any Bidder for a clarification of its Bid. Any clarification submitted by a Bidder 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 in the prices or substance of the Bid shall be sought, offered, or permitted, by the Employer in the evaluation of the Price Bids.

27.2 If a Bidder does not provide clarifications of its bid by the date and time set in the Employer's request for clarification, its bid may be rejected.

28. Deviations, Reservations, and Omissions

28.1 During the evaluation of bids, the following definitions apply:

(a) "Deviation" is a departure from the requirements specified in the Bidding Document;

(b) "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Bidding Document; and

(c) "Omission" is the failure to submit part or all of the information or documentation required in the Bidding Document.

29. Determination of Responsiveness

29.1 The Employer's determination of a bid's responsiveness is to be based on the contents of the bid itself, as defined in ITB11.

29.2 A substantially responsive bid is one that meets the requirements of the Bidding 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 Bidding Document, the Employer's rights or the Bidder's obligations under the proposed Contract; or

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

29.3 The Employer shall examine the technical aspects of the bid submitted in accordance with ITB 16, Technical Bid, in particular, to confirm that all requirements of Section 5 (Works Requirements) have been met without any material deviation or reservation.

29.4 If a bid is not substantially responsive to the requirements of the Bidding Document, it shall be rejected by the Employer and may

not subsequently be made responsive by correction of the material deviation, reservation, or omission.

30. Nonconformities, Errors, and Omissions

30.1 Provided that a bid is substantially responsive, the Employer may waive any nonconformities in the bid that do not constitute a material deviation, reservation or omission.

30.2 Provided that a bid is substantially responsive, the Employer may request that the Bidder submit the necessary information or documentation, within a reasonable period of time, to rectify nonmaterial nonconformities in the bid related to documentation requirements. Requesting information or documentation on such nonconformities shall not be related to any aspect of the price of the bid. Failure of the Bidder to comply with the request may result in the rejection of its bid.

30.3 Deleted

31. Pre-Qualification of the Bidder

31.1 The Employer shall determine to its satisfaction during the evaluation of Technical Bids whether Bidders are qualified to perform the Contract satisfactorily.

31.2 The determination shall be based upon an examination of the documentary evidence of the Bidder's qualifications submitted by the Bidder, pursuant to ITB Clause 17, to clarifications in accordance with ITB Clause 27 and the qualification criteria indicated in Section 3: Evaluation and Qualification Criteria. Factors not included in Section 3: Evaluation and Qualification Criteria shall not be used in the evaluation of the Bidder's qualification.

31.3 An affirmative determination of technical bid shall be a prerequisite for the opening and evaluation of a Bidder's Price Bid. A negative determination shall result into the disqualification of the Bid, in which event the Employer shall return the unopened Price Proposal to the Bidder-

31.4 DELETED

31.5 DELETED

32. Correction of Arithmetical Errors and Omissions in Price Bid and Evaluation of Bid Price

32.1DELETED

(a) DELETED

(b) DELETED

(c) DELETED

(d) DELETED

(e) DELETED

(f) DELETED

(g) DELETED

32.2 DELETED

33. Conversion to Single Currency

33.1 For evaluation and comparison purposes the currencies of the bid shall be converted into Indian Rupees as stated in BDS.

34. Purchase Preference

34.1 The Purchase Preference shall be available to Class-I Local bidder. Margin of Purchase Preference (MPP) shall be as specified in Bid Data Sheet.

34.2 If a bidder or any of its constituents has been debarred by any procuring entity for violation of the 'Public Procurement (Preference to Make in India) Order 2017', shall not be eligible for preference for procurement for the duration of debarment. The debarment for such procuring entities shall take effect prospectively from the date on which it comes to the notice of the Employer.

35. Evaluation of Bids

35.1 The Employer shall evaluate Price Bids of each Bid for which the Technical Bids have been determined to be substantially responsive. The Employer shall use the criteria and methodologies listed in this Clause. No other evaluation criteria or methodologies shall be permitted.

35.2 To evaluate the price Bid of a bid, the Employer shall consider the following:

(a) the bid price, excluding Provisional Sums and the provision, if any, for contingencies in the Summary Bill of Quantities, but including Day Work items, where priced competitively;

(b) DELETED

(c)DELETED

(d) DELETED

(e) application of all the evaluation factors indicated in Section 3 (Evaluation and Qualification Criteria).

35.3 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 bid evaluation.

35.4 If this Bidding Document allows Bidders to quote separate prices for different contracts, and the award to a single Bidder of multiple contracts, the methodology to determine the lowest evaluated price of the contract combinations, including any discounts offered in the Letter of Price Bid, is specified in Section 3 (Evaluation and Qualification Criteria).

35.5 If the bid, which results in the lowest Evaluated Bid Price is substantially on lower side and/or seriously unbalanced in the opinion of the Employer as per criteria defined below, the Employer may require the bidder to submit additional performance security as under:-

a) If overall price quoted by the L1 bidder is below the engineer's estimated price by more than 10% and the difference between overall price quoted by the L1 and L2 is more than 5% of the estimated price, then the bid price of L1 bidder shall be treated as substantially on lower side and such bidder shall be bound to furnish additional performance security equal to the (0.9x engineer's estimated price – L1 price) or (0.95 x L2 price – L1 price) whichever is lower, on this account. Example below demonstrates the method of calculation to arrive at additional performance security:

Suppose overall price quoted by the L1 bidder is 17% below the estimated price and the overall price quoted by L2 bidder is 8% below the estimated price. In this case the overall price quoted by the L1 bidder is lower by more than 10% of the estimated price and also the difference between overall price quoted by the L2 and L1 bidder is more than 5% of the estimated price, hence the L1 bidder shall be required to furnish additional performance security for an amount equal to

{0.9 x engineer's estimated price – (1-17/100) x engineer's estimated price} = {0.07 x engineer's estimated price} = 7% of engineer's estimated price or {0.95 x (1-8/100) x engineer's estimated price – (1-17/100) x engineer's estimated price} = {0.044 x engineer's estimated price} = 4.4% of engineer's estimated price; whichever is lower.

As per the above L1 bidder shall be required to submit additional performance security of 4.4% of engineer's estimated price.

b) If for any bill/ schedule of quantities % age above or below quoted by the bidder on the estimated price is beyond 15% below the overall % age difference between the quoted contract price and the engineers estimated price, then the price for that particular schedule shall be treated as seriously unbalanced and bidder shall be bound to furnish additional performance security for such unbalanced price. Example below demonstrates the method of calculation to arrive at unbalanced price and additional performance security:

Suppose for the L1 bidder overall % age difference between quoted contract price and the engineers estimated price;

(Overall contract price – Overall estimated price) x 100 ÷ overall estimated price = + 4 %

Maximum % age below permitted over estimated price of any bill / schedule in this case = +4 – 15 = -11%

Suppose for the L1 bidder has quoted 20% below estimated price of schedule "A" then the pricing of the schedule A shall be treated as unbalanced and the bidder shall be required to furnish additional performance security for an amount equal to (20 – 11) % of the estimated price of schedule A.

36. Comparison of Bids

36.1 The Employer shall compare all substantially responsive bids to determine the lowest evaluated bid, in accordance with ITB 34 and 35.

37. Employer's Right to Accept Any Bid, and to Reject Any or All Bids

37.1 The Employer reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids at any time prior to contract award, without thereby incurring any liability to Bidders. In case of annulment, all bids submitted and specifically, bid securities, shall be promptly returned to the Bidders.

F. Award of Contract

38. Award Criteria

38.1 The Employer shall award the Contract to the Bidder whose bid is substantially responsive to the Bidding Document, provided further that the Bidder is determined to be qualified to perform

the Contract satisfactorily and whose offer has been determined to be the lowest evaluated subject to ITB 38.2 and 38.3 below. In case of more than one bids are evaluated to be lowest, Contract shall be awarded to the bidder having higher average annual construction turnover (calculated as total certified payments received for contracts in progress or completed) in equivalent INR within the last three financial years.

38.2 The works contracts are not divisible in nature. Hence, following procedure shall be followed for award of the contract:

i. Among all qualified bidders, the lowest bidder will be termed L1. If L1 is 'Class-I local bidder', the contract will be awarded to L1.

ii. If L1 is not 'Class-I local bidder', the lowest bidder among the 'Class-I local bidder', will be invited to match the L1 price subject to Class-I local bidder's price falling within Margin of Purchase Preference (MPP) and the contact shall be awarded to 'Class-I local bidder' subject to matching the price of L1.

iii. In case such lowest eligible 'Class-I local bidder' fails to match the price of L1, the 'Class-I local bidder' with next higher bid within MPP shall be invited to match the price of L1 and so on, and contract shall be awarded accordingly.

iv. In case none of the 'Class-I local bidder' within MPP matches the L1 price, the contract will be awarded to L1 bidder.

38.3 The Employer has the right to review at any time prior to award of contract that the qualification criteria as specified in Section 3: Evaluation and Qualification Criteria are still being met by the Bidder whose offer has been determined to be the lowest evaluated Bid. A Bid shall be rejected if the qualification criteria as specified in Section 3: Evaluation and Qualification Criteria are no longer met by the Bidder whose offer has been determined to be the lowest evaluated Bid. In this event the Employer shall proceed to the next lowest evaluated Bid to make a similar reassessment of that Bidder's capabilities to perform satisfactorily."

The Employer shall award the Contract to the Bidder whose bid is substantially responsive to the Bidding Document, provided further that the Bidder is determined to be qualified to perform the Contract satisfactorily and whose offer has been determined to be the lowest evaluated subject to ITB 38.2 below. In case of more than one bids are evaluated to be lowest, Contract shall be awarded to the bidder having higher average annual construction turnover (calculated as total certified payments received for contracts in progress or completed) in equivalent INR within the last three financial years.

39. Notification of Award

39.1 Prior to the expiration of the period of bid validity, the Employer shall notify the successful Bidder, in writing, that its bid has been accepted by the Competent Authority at EMPLOYER's Corporate Office or CPM's Office. The notification letter (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 and completion of the Works (hereinafter and in the Conditions of Contract and Contract Forms called "the Contract Price") and the requirement for the Contractor to remedy any defects therein as prescribed by the Contract.

39.2 Until a formal contract is prepared and executed, the notification of award shall constitute a binding Contract.

40. Signing of Contract

40.1 Promptly after notification, the Employer shall send the successful Bidder the Contract Agreement.

40.2 Within twenty-eight (28) days of receipt of the Contract Agreement, the successful Bidder shall sign, date, and return it to the Employer.

41. Performance Security

41.1 Within twenty-eight (28) days of the receipt of notification of award from the Employer, the successful Bidder shall furnish the performance security in accordance with the conditions of contract, subject to ITB 35.5, using for that purpose the Performance Security Form included in Section 8: Contract Forms, or another form acceptable to the Employer.

In case the contractor fails to submit Performance Security within 28 days of issue of LOA, it may seek extension of time for a period not exceeding 28 days along with payment of damages either through bank transfer or Demand Draft in favour of EMPLOYER. The rate of payment of damages for such extended period shall be a sum calculated @ 0.035% of the Performance Security for each day of the extension sought. Further, if the last day of the extension sought happens to be a declared holiday in the concerned office, submission of Performance Guarantee shall be accepted on the next working day. Extension of time may be granted by the authority who is competent to sign the contract agreement.

The contractor may commence the work within 42 days of issue of LOA subject to the condition that, no payment will be made to the contractor till completion of the following: -

1. Submission of Enforceable Performance Guarantee
2. Signing of Contract agreement.

In case contract is terminated on account of non-submission of Performance Security within the specified time or extended time, the Employer shall be entitled to forfeit Bid Security, damages paid if any, and other dues payable against that contract.

41.2 Failure of the successful Bidder to submit the above-mentioned Performance Security or to sign the Contract Agreement shall constitute sufficient grounds for the annulment of the award and forfeiture of the bid security.

41.3 The above provision shall not apply to the furnishing of a Domestic Preference Security, if so required.

42. Jurisdiction of Courts

The bidding process shall be governed by and construed in accordance with the laws of India and the Courts as indicated in Bid Data Sheet shall have exclusive jurisdiction over all the disputes/issues arising under, pursuant to and/ or in connection with the bidding process.

43. Make In India

43.1 The provisions of revised 'Public Procurement (Preference to Make in India) Order 2017' issued by Department of Industrial Policy and Promotion under Ministry of Commerce and Industry vide letter no. P-45021/2/2017-PP (BE-II) dated 16.09.2020, as amended from time to time up to 28 days prior to deadline for submission of bids, shall be applicable to the bidding process and award of the contract shall be done accordingly.

43.2 **Local Content**: The amount of value added in India, which unless otherwise prescribed by Railway Ministry, be the total value of the item procured (excluding net domestic indirect taxes) minus value of imported content in the item (including all custom duties) as proportion of total value, in percent. Services such as transportation, insurance, installation, commissioning, training, and after sales services like AMC / CMC etc. are not local value addition for an imported product.

***

Section 2

Bid Data Sheet (BDS)

[Section 2: Bid Data Sheet (BDS)]

This section consists of provisions that are specific to each procurement and supplement the information or requirements included in Section I – Instructions to Bidders.

A. Introduction

ITB 1.1	The number of the Invitation for Bids is*:* HORC/HRIDC/Patli/S&T/2023
ITB 1.1	The Employer is: **Haryana Orbital Rail Corporation Limited**
ITB 1.1	The name of the NCB is: **Design, Supply, Installation, Testing & Commissioning of Signalling & Telecommunication system in connection with yard remodelling at Patli station (Existing N. Rly. station in Delhi-Rewari section) for Haryana Orbital Rail Corridor (HORC) Project.**
ITT 1.3	**Add new sub-clause ITT 1.3** **Instructions for Online Bid Submission:** The Bidders are required to submit soft copies of their Bid 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 Bidders in registering on the e-procurement Portal, prepare their bids in accordance with the requirements and submitting their Bids online on the eProcurement Portal. **Registration:** i) Bidders are required to enrol 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 Bidders will be required to choose a unique username and assign a password for their accounts. iii) Bidders 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. **A. Obtaining a Digital Certificate:** i. The Bids submitted online should be encrypted and signed electronically with a Digital Certificate to establish the identity of the Bidder 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 Bidders 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 Bidder 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.

For any queries related to e-Bidding process (registration, online e-bid submission/withdrawal, uploading of documents), Bidder may contact the below representative of NIC:

Ms. Manju Aggarwal
Technical Director,
Scientist-E, NIC.
Panchkula.
E - mail: a.manju@nic.in
Help Desk: 0172 – 584257, 94170-69017.

v. Bidder for a particular Bid must be submitted online using the digital certificate (Encryption & Signing), which is used to encrypt and sign the data during the stage of Bid preparation. In case, during the process of a particular Bid, 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 Bid 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 Bidding, if the digital certificate issued to the authorized user of a firm is used for signing and submitting a Bid, it will be considered equivalent to a no-objection certificate/power of attorney/lawful authorization to that User. 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 Bidder on behalf of the firm in the department Bids as per Information Technology Act 2000. The digital signature of this authorized user will be binding on the firm.

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: For purchasing the Bid documents online, Bidders are required to pay the Bid documents 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 Bidding:** In order to operate on the electronic Bid 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 Invitation of Bids (IFB):** The Bidders can view the IFB 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 Bid Documents:** The Bid documents can be downloaded free of cost from the eProcurement portal https://etenders.hry.nic.in **F. Key Dates:** The Bidders are strictly advised to follow dates and times as indicated in the online Invitation of Bids. The date and time shall be binding on all Bidders. 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 Invitation of Bids. **G. Online Payment of E-Service Fee:** The online payment for E-Service Fee in INR shall be made using the secure electronic payment gateway by Bidders 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. Preparation & Submission of online Applications/Bids: i. Detailed Bid documents may be downloaded from eProcurement website (https://etenders.hry.nic.in) from **21.04.2023 (09:00 Hrs. IST) to 19.*05.2023* (15:00 Hrs IST.)** and Bid mandatorily be submitted online following the instruction appearing on the screen. ii. **Scan copy of Documents to be submitted/uploaded for Technical Bid 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) and uploaded during the on-line submission of PQQ or Technical Envelope. **iii. Price Bid shall be submitted mandatorily online under Commercial Envelope and original not to be submitted manually** ***NOTE:*** ***(A) Bidders participating in online Bids shall check the validity of his/her Digital Signature Certificate before participating in the online Bidss at the portal*** https://etenders.hry.nic.in***.*** ***(B) For help manual, please refer to the 'Home Page' of the*** **eProcurement** ***website at*** https://etenders.hry.nic.in
ITB 4.1(b)	Joint Venture/Consortium is not permitted to participate in this Bid
ITB 4.1 c	Shall not be applicable being a Domestic Bidding.
ITB 4.1 d	Shall not be applicable being a Domestic Bidding.
ITB 4.1 e	Eligible Bidder for this work is *'Class-I Local'*
ITB 4.4 h	Shall not be applicable being a Domestic Bidding.
ITB 4.4 i	Shall not be applicable being a Domestic Bidding.

B. Bidding Documents

ITB 7.1	For **Clarification of Tender purposes** only, the Employer's address is: **Attention:** Mr. Shiv Om Dwivedi **Designation:** Chief Project Manager **Street address:** Haryana Rail Infrastructure Development Corporation Limited (HRIDC), Plot no.143, Railtel Tower, Sector-44 **Floor:** 5th floor **City:** Gurugram **ZIP code:** 122003 **Country:** India **Telephone:** +91 9311478893 **E-mail:** horc.etendering@gmail.com

<table>
<tr><td>ITB 7.4</td><td>Replace the entire Sub-Clause 7.4 with the following:

There will be NO Pre-Bid Meeting for this Bid. However, Bidder may submit their Bid related queries in the following format:

<table>
<tr><th>Query No.</th><th>Reference to Bid Document

(Clause/ Para No. & Page No.)</th><th>Brief Description of Clause/ Para No.</th><th>Query Raised</th></tr>
<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>5.</td><td></td><td></td><td></td></tr>
<tr><td>etc.</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>

The prospective Bidders can submit their Bid related queries through email along with an editable soft copy (MS Word) on the email id (i.e. horc.etendering@gmail.com).</td></tr>
<tr><td>ITB 7.5</td><td>The Bidder shall submit any Bid related queries in writing, to reach the Employer not later than 01.05.2023,1800hrs IST.</td></tr>
<tr><td>ITB 7.6</td><td>Replace ITB 7.6 with the following:

Response to Bid related queries, without identifying the source, will be uploaded on e-Procurement portal, https://etenders.hry.nic.in. Any modification to the Bid Document that may in the sole discretion of the Employer become necessary as a result of the Bid related queries shall be made by the Employer exclusively through the use of an Addendum/Corrigendum pursuant to ITB 8.</td></tr>
<tr><td>ITB 8.2</td><td>Replace ITB 8.2 with the following:
Any addendum/Corrigendum issued shall be part of the Bid Documents and shall be uploaded on eProcurement portal, https://etenders.hry.nic.in .
The onus is on the Bidders to visit the eProcurement portal to see the addenda published by the Employer.</td></tr>
</table>

C. Preparation of Bids

ITB 10.1	The language of the bid is: **English.** All correspondence exchange shall be in **English** language.

ITB 11.2	Alternative technical solutions **are not** permitted.
ITB 11.4 (f)	Checklist as per Form No. 2 given in Section 4: Bidding Forms
ITB 13.1	Alternative bids **will not be** permitted.
ITB 13.2	Alternative times for completion **will not be** permitted.
ITB 14.5	The prices quoted by the Bidder shall NOT be adjustable in accordance with the provisions in Sub Clause 13.8 of SCC, Section 7, Part A; Contract Data, Special Conditions of Contract.
ITB 15.1	The currency of the Bid and the payment currency shall be **Indian Rupees (**INR) only. The prices shall be quoted by the Bidder entirely in **Indian Rupees (INR) only.**
ITB 18.1	The bid validity period shall be 120 **(One hundred and twenty only)** days.
ITB 19.1	The Bidder shall furnish a Bid Security for an amount of INR 4,00,000/- (INR Four Lacs only).
ITB 19.2	Not Applicable
ITB 19.3	Replace the ITT 19.3 with the following: The amount for Bid Security will only be paid online by eligible Bidders on eProcurement Portal in favor of Haryana Rail Infrastructure Development Corporation Limited using the electronic payment gateway service.
ITB 20.2	The written confirmation of authorization to sign on behalf of the Bidder shall consist of: (a) In case of Private/Public Companies or Limited Liability Partnership (LLP) firms, 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. (b) In case of Proprietory Bidder, Power of Attorney by the Proprietor. (c) In case of Partnership firms, Power of Attorney duly signed by all the Partners. (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 Bid on behalf of the LLP and create liability against the LLP. (e) In case of Joint Venture/Consortium, Power of Attorney duly signed by authorized representative of individual Member in favour of the Lead Member and Authorized representative of JV/Consortium.

D. Submission and Opening of Bids

ITB 22.1	For Bid submission purposes eProcurement website address is: https://etenders.hry.nic.in . The start date for Bid submission is: Date: 12/05/2023. Time: 11:00 hrs. IST The deadline for Bid submission is: Date: 19/05/2023. Time: 15:00 hrs. IST
ITB 25.1	The online bid opening shall take place at eProcurement portal https://etenders.hry.nic.in. **Bid Opening**: Date: 19/05/2023. Time: 15:30 hrs. IST
ITB 34.1	Not Applicable
ITB 35.5	**Replace ITT 35.5 with the following:** An Abnormally Low Bid is one in which the bid price, in combination with other elements of the Bid, appears so low that it raises material concerns as to the capability of the bidder to perform the contract at the offered price. The Employer may in such cases seek written clarifications from the bidder, including detailed price analysis of its bid price in relation to scope, schedule, allocation of risks and responsibilities, and any other requirements of the bids document. If, after evaluating the price analyses, the Employer determines that the bidder has substantially failed to demonstrate its capability to deliver the contract at the offered price, the Employer may reject the bid/ proposal. No Additional Performance Security deposit in case of abnormally low bids shall be taken. However, whenever there are compelling circumstances to ask for Additional Performance Security in case of abnormally low bids, the same shall be taken only with the approval of the next higher authority to the authority competent to finalize the particular Bid and the bidder shall be bound to furnish such additional Performance Security.

ITB 38.1	"The Employer shall award the Contract to the Bidder whose bid is substantially responsive to the Bidding Document, provided further that the Bidder is determined to be qualified to perform the Contract satisfactorily and whose offer has been determined to be the lowest evaluated subject to ITB 38.2 and ITB 43 below. In case of more than one bids are evaluated to be lowest, Contract shall be awarded to the bidder having higher average annual construction turnover (calculated as total certified payments received for contracts in progress or completed) in equivalent INR within the last three financial years."
ITB 42	Gurugram, Haryana

Section 3

Evaluation & Qualification Criteria (EQC)

Section 4

Bidding Forms

Section III – Evaluation and Qualification Criteria

Table of Criteria

1. Evaluation

In addition to the criteria listed in ITB 35.2 (a)-(e), the following criteria shall apply:

1.1. Adequacy of Technical Bid

Evaluation of the Bidder's commitment for the contract consistent with the requirements stipulated in Section 5: Works Requirements regarding work methods and scheduling as submitted by Bidder in Form T-1.

1.2. Multiple Contracts

Multiple Contracts are not envisaged.

1.3. Completion Time

Alternative Completion Time is not permitted.

1.4. Technical Alternatives

Technical alternatives are not permitted

1.5. Margin of Preference

1.5.1. Purchase Preference to Central Public Sector Enterprises (CPSEs)

Purchase Perference to CPSEs shall not apply.

1.5.2. Preference to Make in India

Preference as defined in ITB clause 43 shall be applicable.

2. Qualification

2.1 Eligibility

Criteria	Compliance Requirements				Documents Submission Requirements
	Single Entity	Joint Venture			
		All Partners Combined	Each Partner	Lead Partner	
2.1.1 Conflict of Interest					
No Conflict of interest in accordance with ITB Sub-Clause 4.3.	Must meet requirement	N. A.	N. A.	N. A.	Letter of Technical Bid (Form PS 1)
2.1.2 Share of partners					
The share of partners shall not be less than the specified percentage.	N. A.	N. A.	N. A.	N. A.	MoU or JV Agreement Form JV 4 or JV 5
2.1.3 Disqualification of Bidder					
Not Disqualified under Clause 4.4 of ITB.	Must Meet Requirement	N. A.	N. A.	N. A.	Letter of Technical Bid (Form PS 1) & Affidavit (Form PS 3)

2.2 Financial Status

Criteria	Compliance Requirements				Documents Submission Requirements
Requirement	Single Entity	Joint Venture			
		All Partners Combined	Each Partner	Lead Partner	
2.2.1 Historical Financial Performance					
The Bidder must demonstrate that the current soundness of the Bidders financial position. As a minimum criteria, Profit Before Tax (PBT) should be positive for two financial years out of last five financial years.	Must meet requirement	N. A.	N.A.	N. A.	Form FIN – 1 with attachments
2.2.2 Average Annual Construction Turnover :					
Minimum average annual construction turnover in equivalent INR **5 Crores** Calculated as total certified payments received for contracts in progress or completed, within the last **three** financial years (refer note below the table).	Must meet requirement	N. A.	N. A.	N. A.	Form FIN – 2
2.2.3 Net –Worth					
Minimum average Net-Worth (Total Assets – Total Liabilities) should be **positive** during the last three financial years (refer note below the table).	Must meet requirement	N. A.	N. A.	N. A.	Form FIN – 1

2.2.4 Bid Capacity					
The available Bid capacity should be equal to or more than **INR 5.00 crores** . The available Bid capacity will be calculated as per Item No. 1 of Form FIN- 3.	Must meet requirement	N. A.	N. A.	N. A.	Form FIN – 2 & 3

Note: In the event that the audited accounts for the latest concluded Financial Year are not available, the Bidder shall furnish information pertaining to the last five financial years after ignoring the latest concluded financial year. In case the bidder submits audited financial information for the last six or more years, only the figures for the latest five years shall be considered for evaluation.

2.3 Experience

Criteria	**Compliance Requirements**				**Documents Submission Require-ments**
Requirement	**Single Entity**	**Joint Venture**			
		All Partners Combined	**Each Partner**	**Lead Partner**	
2.3.1 Specific Construction Experience					
2.3.1 (a) Contracts of Similar Size and Nature. (I) Execution as a Contractor, JV member or subcontractor in at least One contract having minimum value of **INR 3.00 Crores.** **OR** (II) Execution as a Contractor, JV member or subcontractor in at least two Contracts, each having minimum value of **INR 2.00 Crores.** The Contracts in I or II above must have been successfully or substantially completed within the last Seven years before the deadline for submission of the bids, and should be similar to the proposed work. The similar work here shall be that Contract which includes installation, testing and commissioning of EI/SSI/PI/RRI works of at least One (01) station in railway contract. **Note:** Total number of stations for *work requirement (Q)/*bidders' experience shall be calculated as under: a) For new EI/PI/SSI/RRI works *to be commissioned in the work/*commissioned: - 1 x number of stations	Must meet requirement of either (I) or (II)	N. A.	N. A.	N. A.	Form EXP - 2(a)

involving indoor and outdoor signalling works - + 0.5 number of stations involving only outdoor signalling works + 0.5 number of stations involving only indoor signaling works. b) For modification works of existing EI/PI/RRI/MACLS with end cabin Lever frames installations *to be commissioned in the work*/commissioned to suit Railway Electrification works: - 0.5 x number of stations involving RE modification signaling works c) For new Automatic Signalling works *to be commissioned in the work*/ commissioned:- 0.1 x Number of Automatic Signals (excluding Advance Starter, Starter and Home Signals of the Station) c) No other alteration/ modification work shall be considered.)					

Note:-

(1) (a) For the purpose of value of work for the past experience of a firm in a JV in sub clause 2.3.1(a) credit shall be given in proportion of the percentage share of the firm in that JV. For past experience of key activities in sub clause 2.3.1(a) credit shall be given for execution of the quantity of that specific activity executed by the firm as part of a JV, duly certified by the Employer. If the Employer's Certificate does not indicate the specific quantity of key activity/activities executed by each partner, in such a case credit for quantity of each 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.

(b) In case a JV quoting for the Bid has executed similar work specified in 2.3.1(a), with the same constitution of JV, the requirement specified to be met under sub clause 2.3.1(a) shall be considered to have been met treating the JV as a single entity for this purpose.

(2) The phrase "substantial completion" used in clause 2.3.1 (a) shall mean where the employer has certified:

Ongoing works where required value of the work as well as required quantity of key activity has been physically completed. The same should be supported by Employer's certificate.

IMPORTANT NOTE FOR SPECIAL ATTENTION OF BIDDERS:

EACH BIDDER SHOULD SUBMIT DETAILS/REFERENCES AS TO HOW THE ELIGILIBILITY CRITERIA IS BEING MET BY THE BIDDER AGAINST EACH ITEM OF EQC. THIS SHOULD BE PREPARED AND SUBMITTED IN THE PERFORMA "EQC FORM NO.1" ENCLOSED IN SECTION 4.

Section 4: Bidding Forms

This Section contains the forms which are to be completed by the Bidder and submitted as part of his Bid

Table of Forms

Form: PS 1

Letter of Technical Bid

Date: …….
Invitation for Bid No.: ……..

To:……

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Documents, including Addenda/Corrigenda issued in accordance with Instructions to Bidders (ITB) 8;

(b) We offer to execute the Works in conformity with the Bidding Documents;

(c) Our bid shall be valid for a period of **120 days** from the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(d) If our bid is accepted, we commit to obtain a performance security in accordance with the Bidding Documents;

(e) If our bid is accepted, we commit to deploy key equipment and key personnel consistent with the requirements stipulated in Section 5: Works Requirements;

(f) If our bid is accepted, we commit to submit work method statements for all major activities and get these approved from the engineer prior to commencing work on such activities. We also understand that the work shall be executed as per the approved method statements without any deviations;

(g) We, including any subcontractors or suppliers for any part of the contract, do not have any conflict of interest in accordance with ITB 4.3;

(h) We are not participating, as a Bidder or as a subcontractor, in more than one bid in this bidding process in accordance with ITB 4.3, other than alternative offers submitted in accordance with ITB 13;

(j) If our bid is accepted, we will not sub-contract any work to a contractor from a bidder of a country which share a land border {Details in clause ITB 4.1 (d)} with India unless such contractor is registered with the Competent Authority.

(k) i. We declare that we are not liable to be disqualified in accordance with ITB 4.4, and we are enclosing the affidavit for the same as per the Performa given in the bid document.

ii. We understand that if at the time of evaluation of the bid or during execution of the contract, the declaration regarding local content, submitted thorough the relevant form provided in Section 4 Bidding Forms, is found to be false, it will be treated as breach of Code of Integrity under Rule 175(1)(i)(h) of the General Financial Rules for which the Bidder or its successors can be debarred up to two years along with such other actions as may be permitted by law.

iii. We have also enclosed declaration in Form-MII and also a certificate, in case the estimated cost of the work is more than ₹10 Cr, from statutory auditor or cost auditor of the company or from practicing cost accountant or chartered accountant.

iv. We also undertake that the 'Local Content' added in the entire work will have to be submitted along with the final bill.

(l) We understand that this bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed; and

(m) We have not made any deviations from the requirement of the bidding document and we have also not made any tampering or changes in the bidding documents on which the bid is being submitted and if any tampering or changes are detected at any stage, we understand the bid will invite summary rejection and forfeiture of bid security/the contract will be liable to be terminated along with forfeiture of performance security, even if LOA has been issued.

(n) If our bid is accepted, we opt to take payment into the bank account, nominated by us.

(o) We declare that the submission of this bid confirms that no agent, middleman or any intermediary has been, or will be engaged to provide any services or any other item of work related to the award and performance of this contract. We further confirm and declare that no agency commission or any payment which may be construed as an agency commission has been, or will be, paid and that the bid price does not include any such amount. We acknowledge the right of the Employer, if he finds to the contrary, to declare our bid to be noncompliant and if the contract has been awarded to declare the contract null and void

(p) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive.

Name ……..

In the capacity of ……

Signed ……..

Duly authorized to sign the Bid for and on behalf of ……

Date ……

Letter of Price Bid

Date: .....

Invitation for Bid No.: .....

To: .....

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (ITB) 8;

(b) We offer to execute the Work in conformity with the Bidding Documents;

(c) The total price of our Bid is indicated in the **Summary Sheet of Bill of Quantities**;

(d) We understand that this bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed; and

(e) We have not made any deviations from the requirement of the bidding document and we have also not made any tampering or changes in the bidding documents on which the bid is being submitted and if any tampering or changes are detected at any stage, we understand the bid will invite summary rejection and forfeiture of bid security/the contract will be liable to be terminated along with forfeiture of performance security, even if LOA has been issued.

(f) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive.

Name .....

In the capacity of .....

Signed .....

Duly authorized to sign the Bid for and on behalf of .....

Date .....

Form: PS 3

FORMAT FOR AFFIDAVIT TO BE SUBMITTED BY BIDDER ALONGWITH THE BID

*(To be executed in presence of Public Notary on non-judicial stamp paper of the appropriate value in accordance with relevant stamp Act. The stamp paper has to be in the name of the bidder)***

I ***…….. (Name and designation)**……*** appointed as the attorney/authorized signatory of the bidder (including its constituents), M/s. _____ (hereinafter called the bidder) for the purpose of the Bid for the work of _____ as per the bid No._____ of HORCL/HRIDC, do hereby solemnly affirm and state on behalf of the bidder including its constituents as under:

*1. That the bidder or any of its constituents has not been Blacklisted/ banned for business dealings for all Government Departments or by Ministry of Railways or by HORCL/HRIDC at any time and/or no such blacklisting is in force as on the deadline for submission of bids.

*2. That none of the previous contracts of the bidder or any of its constituents had been terminated/rescinded for Contractor's failure or part terminated for its failure as a JV partner with forfeiture of its full Performance Security, by Haryana Rail Infrastructure Development Corporation Limited during the period of last 3 years before the deadline for submission of bids.

(Add Proviso of Clause 4.4(b) (ITB) suitably, if any Contract was so terminated).

*3. The bidder or any of its constituents has not been imposed liquidated damages of 5% or more of contract value by HORCL/HRIDC due to delay in the implementation of any previous contract (either in the capacity of a single entity or as constituent of any other JV) within the period of last 2 years before the deadline for submission of bid [*2 years shall be reckoned from the date on which imposed L.D. has exceeded 5% of the contract price]*and there are no such accrued delay damages which has not been fully recovered before the deadline for submission of bids on account of contractor's request for deferring recovery to maintain cash flow and HORCL/HRIDC has acceded to the same in the interest of the project and the work under the previous contract in question has been completed before the deadline for submission of bid, unless imposition of such delay damages has been set aside by the Competent Authority.

4. That the Bidder or any of its constituents is neither Bankrupt/Insolvent nor is in the process of winding-up nor such a case is pending before any Court on the deadline of submission of the bid.

*5. That the name of the Bidder or any of its constituents is not on the list of "Poor Performer" of HORCL/HRIDC as on the deadline for submission of bid.

6. We declare that the bidder or any of its constituents have not either changed their name or created a new business entity as covered by the definition of "Allied Firm" under para 1102 (iii) of chapter XI of Vigilance manual of Indian Railways with latest amendments and corrections (available on website of Indian Railways), consequent to having been banned business dealings for specified period which is not over or suspended business dealings or having been declared as poor performer.

7.# We declare and certify that 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.

*(# - Delete whichever is not applicable)***.*

8. That the bidder or any of its constituents is not an Entity of such countries, which have been identified by the Railway Ministry as not allowing Indian Companies to participate in their Government procurements for any item related to Railway Ministry, except for the list of items published by the Railway Ministry permitting their participation.

9. That the bidder or any of its constituents has not committed any previous transgressions in respect of Code of Integrity [Rule 175 (1) of General Financial Rules 2017] with any entity in any country during the last three years or of being debarred by any other procuring entity

10. 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.

11. We declare that the information and documents submitted along with the Bid by us are correct and we are fully responsible for the correctness of the information and documents, submitted by us.

12. "We have read the clause regarding restrictions on procurement from a bidder of a country which share a land border with India and I certify that :

@ This Bidder is not from such a country

OR

This Bidder is from such a country and the bidder has been registered with the Competent Authority

13. We understand that in case we cease to fulfill the requirements of qualifying and eligibility criteria at any time after opening of bids and till finalization of bids, it will be our bounden duty to inform the Employer of our changed status immediately and in case of our failure to do so, our bid shall be rejected and bid security shall be forfeited. In case such failure comes to the notice of Employer at any time after award of the contract, it will lead to termination of the contract and forfeiture of Bid or Performance Security. We shall also be liable for Banning of Business dealings upto a period of five years.

14. We understand that if the contents of the affidavit are found to be false at any stage during bid evaluation, it will lead to rejection of our bid and forfeiture of the bid security. Further, we ***[insert name of the bidder]*****_____ and all our constituents understand that we shall be liable for banning of business dealings upto a period of five years.

15. We also understand that if the contents of the affidavit are found to be false at any time after the award of the contract it will lead to termination of the contract, forfeiture of Bid or Performance Security and Banning of Business dealings of the Bidder and all its constituents for a period of upto five years.

SEAL AND SIGNATURE OF THE BIDDER

Verification:

Verified on _____ day of _____ at _____ that the contents of the above mentioned affidavit are true and correct and nothing material has been concealed there from.

SEAL AND SIGNATURE OF THE BIDDER

**Modify the contents wherever necessary, in terms of sub-clause 4.4 ITB.*

*** The contents in Italics are only for guidance purpose and details as appropriate, are to be filled in suitably by Bidder.*

Attestation before Magistrate/Public Notary

@ Strike out whichever is not applicable. In case the bidder is from a country which share a land border with India, evidence of valid registration by the Competent Authority shall be attached.

Form: BDF/1

Bid Security

The amount for Bid Security will only be paid online by eligible Bidders on eProcurement Portal of Government of Haryana.

Form : BDF/2

Bid Security Declaration Form

DELETED

Form T-1

1. Outline Method Statement

2. Work Schedule

Bill of Quantities (BOQ)

For Bill of Quantities, Please refer Volume-II

Bidders Qualification

To establish its qualifications to perform the contract in accordance with Section 3 (Evaluation and Qualification Criteria) the Bidder shall provide the information requested in the corresponding Information Sheets included hereunder.

Form ELI - 1: Bidder's Information Sheet

Bidder's Information	
Bidder's legal name	
Bidder's country of constitution	
Bidder's year of constitution	
Bidder's legal address in country of constitution	
Bidder's authorized representative (name, address, telephone numbers, fax numbers, e-mail address)	

The Bidder shall attach copies of the following original documents with the form:

1. Articles of incorporation or constitution of the legal entity named above, in accordance with ITB 4.1 and 4.2.

Form FIN-1: Financial Situation

NAME OF BIDDER:

	Financial Data [Indian National Rupees]				
	Year 1:2019-20	Year 2:2020-21	Year 3:2021-22	Year 4:	Year 5:
1. Total Assets				Not Applicable	
2. Current Assets					
3. Total Liabilities					
4. Current Liabilities					
5. Net Worth [= 1 – 3]					
6. Working Capital [= 2 - 4]					
7. Profit Before Tax (PBT)					

_____

SEAL AND SIGNATURE OF THE BIDDER

Certified that all figures and facts submitted in this form have been furnished after full consideration of all observations/notes in Auditor's reports.

_____

(Signature of CA/Auditor)

Name of CA/Auditor:_____

Registration No: _____

_____

(Seal)

Notes:

1. *The Bidder is not required to submit any document as documentary evidence along with the Bid Documents. All information furnished in this Form shall be certified by a Chartered Accountant/Company Auditor/Statutory Auditor.*
2. *The above documents shall reflect the financial situation of the legal entity or entities comprising the Bidder and not the Bidder's parent companies, subsidiaries, or affiliates.*

3. In the event that the audited accounts for the latest concluded Financial Year are not available, the Bidder shall furnish information pertaining to the last three financial years after ignoring the latest concluded financial year. In case, the bidder submits audited financial information for the last four or more years, only the figures for the latest three years shall be considered for evaluation.

Form FIN-2: Annual Construction Turnover

NAME OF BIDDER:

Annual Turnover Data (Construction only)			
Year	**Amount Currency**	**Exchange Rate**	**Indian National Rupees Equivalent**
2019-20			
2020-21			
2021-22			
		Average Annual Construction Turnover	

Certified that all figures and facts submitted in this form have been furnished after full consideration of all observations/notes in Auditor's reports.

_____

(Signature of CA/Auditor)

Name of CA/Auditor:_____

Registration No: _____

_____

(Seal)

1. The Bidder is not required to submit any document as documentary evidence along with the Bid Documents. All information furnished in this Form shall be certified by a Chartered Accountant/Company Auditor/Statutory Auditor..

3. In the event that the audited accounts for the latest Financial Year are not available, the Bidder shall furnish information pertaining to last three financial years after ignoring the latest financial year. In case the bidder submits audited financial information for the last four or more years, only the figures for the latest three years shall be considered for evaluation.

Form FIN-3: Bid Capacity

1.0 Bid Capacity:

The available bid capacity shall be calculated as under:
Available Bid Capacity = [A x N x 2] – 0.33xNxB
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 Bid has been invited

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

Note:

(a) The Bidder (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 Bidder and also the works which are awarded to Bidder but yet not started upto the date of inviting the Bid 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, the Bidder/s failed to submit the above statement along with offer, their/his offer shall be considered as incomplete and will be rejected **summarily**.

(c) The Available Bid Capacity of Bidder shall be assessed based on the details submitted by the Bidder. 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 Bidder has been found eligible in other eligibility criteria/ Bidder requirement**.**

2.0 Bidder 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	Stipulated Period of completio n	Value of balance work yet to be done in INR equivalent upto the date of inviting the Bid
(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 Bid						**B=**

Notes:

(i) Where a work is undertaken by a JV/Consortium, 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/Consortium be excluded.

(ii) The Bidder is not required to submit any document as documentary evidence along with the Bid 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 Bidder and not the Bidder'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 Bid 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** (in INR Equivalent)	
N= Number of years prescribed for completion of work for which Bid has been invited (in years)	
B= Existing commitments and balance amount of ongoing works with Bidder and also the works which are awarded to Bidder but	

Description	Value
yet not started upto the date of inviting the Bid (in INR Equivalent)	
Bid Capacity (in INR Equivalent) = [A x N x 2] – 0.33xNxB	

Certified that all figures and facts submitted in this form have been furnished after full consideration of all observations/notes in Auditor's reports.

_____

(Signature of CA/Auditor)

Name of CA/Auditor:_____

Registration No:_____

_____

(Seal)

Form EXP-2(a): Specific Construction Experience

Fill up one form per Contract

Contract of Similar Size and Nature			
Contract No.		**Contract Identification**	
Award Date		**Completion Date**	
Role in Contract	❑ **Contractor**	❑ **JV member**	❑ **Subcontractor**
Total Contract Amount	**INR**		
If partner in a JV or subcontractor, specify participation in total contract amount	**Percent of Total:**	**Amount: INR**	
Employer's Name, Current Address and Current Telephone/Fax Number, E-mail			
Description of the similarity in accordance with Criteria 2.3.1 (a) of Section 3			

The bidder shall attach a copy of the Certificate(s) issued by the employer in support of the information being furnished in each Exp (2a) form, failing which the claim of the bidder shall be liable to be rejected (in case of experience as a sub-contractor, the employer shall be the owner of the Project who has engaged the main Contractor).

EQC FORM NO.1

Clause No & Clause heading	Details of value of work/quantity of activity and References (Folio No.) of Documents through which criteria against each item is being met.
1 1.1 Adequacy of Technical Bid Form T-1	
2 Qualification	
2.1.1 Conflict of Interest	
2.1.2 Share of partners	Not Applicable
2.1.3 Disqualification of Bidder	
2.2 Financial Status	
2.2.1 Historical Financial Performance	
2.2.2 **Average** Annual Construction Turnover	
2.2.3 Net Worth	
2.2.4 Bid Capacity	
2.3 Experience	
2.3.1 Specific Construction Experience (a) Contracts of Similar Size and Nature (i) Single Contract (ii) Two Contracts	

FORM NO. 2

CHECKLIST FOR CLAUSES PERTAINING TO SUMMARY REJECTION OF BID

We, the undersigned, declare that we have read and understood the content of ITB clauses mentioned below. We also understand that our bid shall be summarily rejected in case we fail to comply the requirements of undermentioned clauses;

ITB Clause No.	Reason for Summary Rejection
4.4	Non-submission of Affidavit
4.5	Non-submission of immediate information to the Employer in case Bidder ceases to fulfill eligibility in terms of ITB 4.3 & 4.4
14.2	Quoting more than one percentage for any Bill Nos.
14.9	Non-submission of the Letter of Price Bid (LPB) and/or Summary sheet of BOQ
16.4	Non-submission of the Letter of Technical Bid (LTB)
19.3	Bid not accompanied by an enforceable and compliant bid security

SEAL AND SIGNATURE OF THE BIDDER

Form-MII

Declaration for 'Local content' in terms of 'Public Procurement (Preference to Make in India) Order 2017', as amended up to 28 days prior to deadline for submission of bids, issued by Department of Industrial Policy and Promotion under Ministry of Commerce and Industry

Ref: Bid Notice No……

I / We declare that:

1. The offer submitted against the meets the 'Local Content' requirement as prescribed vide clause ITB 4.1 e and ITB 43.2.
2. The details of the local content and location(s) where local value addition is made in case of imported items, are as below:

BOQ Item no	Description in brief	BOQ Amount	Made in India Items: Amount of local content	Imported Items: Value added in India	Imported Items: Location of Value added in India
1					
2					
….					
Total		**A**	**B**	**C**	

Total Local Content: B + C
% of local content in total BOQ cost: …..%

3. Fulfilment of the aforesaid requirements shall also be ensured from the subcontractors and that the above statement contains information for the entire contract.

SEAL AND SIGNATURE OF THE BIDDER

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CHAPTER 1 - GENERAL

1.1 DEFINITIONS

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:

1.1.1 "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.

1.1.2 "Auxiliary/Subsidiary signals" Shunt signals — Independent or below Main signals, Calling-on signals, Route indicators.

1.1.3 "Availability" means the probability that an item will be in a state to perform a required function under given conditions, at a given instant in time or over a time interval, assuming that the given external resources are provided.

1.1.4 "Apportionment" process whereby the RAMS elements for a system are sub-divided between the various items which comprise the system to provide individual targets

1.1.5 "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

1.1.6 "Compliance" demonstration that a characteristic or property of a product satisfies the stated requirements.

1.1.7 "Condition of Contract" shall mean General Conditions of Contract read in conjunction with Particular Conditions of Contract as in Part 3 of Bidding Documents.

1.1.8 "Construction/Installation and/or Manufacture Documents" means all drawings, calculations, computer software, samples, patterns, models, operation and maintenance manuals and other manuals and information of a similar nature to be submitted by the Contractor.

1.1.9 "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.

1.1.10 "Corrective Maintenance" means maintenance performed to correct the occurrence of an equipment or system fault.

1.1.11 "Defect" is any part of the Work which is not in accordance with the Contract.

1.1.12 "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-4, Design Requirements of this Document.

1.1.13 "Design Criteria" means the governing specifications and conditions as specified in Chapter-4 of this Document.

1.1.14 "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.

1.1.15 "Design life" The design life is the period of time during which the system is expected to work satisfactorily within its specified parameters.

1.1.16 "Design Manual" means the manual to be prepared and submitted by the Contractor as part of the Preliminary Design and as described in Chapter-4 of this Document.

1.1.17 "Design Phase" has the meaning identified in Chapter-4 of this Document.

1.1.18 "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.

1.1.19 "Down time" time interval during which a product is in a down state.

1.1.20 "Drawings" means the Employer's 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.

1.1.21 The "Engineer" means the PMC 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

1.1.22 "Factory Acceptance Tests" all 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.

1.1.23 "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.

1.1.24 "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.

1.1.25 "Hazard" is a physical situation with a potential for human injury and/or damage to environment

1.1.26 "Interfacing Contractor" means the Contractor engaged by the Employer or other agencies having an interface issue with the Contractor for this Work.

1.1.27 "Interfacing Parties" comprises 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.

1.1.28 "Interface coordinator" is an official appointed by the contractor to Coordinate the Interface requirement and organize the interaction between interfacing parties and organize interface.

1.1.29 "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 interfacing parties and manage the interface requirement within its agreed scope

1.1.30 "Line Replaceable Unit (LRU)" means equipment that can be replaced as a single complete unit and can be handled by a single person.

1.1.31 "Main running signals" Home signal, Starter signal, Intermediate Starter signal, Advance Starter signal.

1.1.32 "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.

1.1.33 "Man Machine Interface (MMI)" means the visual interface between the Controller and the control system. The MMI consists of the computer screens, displayed objects, icons, and equipment as well as the facilities by which the Controller executes control.

1.1.34 "Mean Time to Restore (MTTR)" means the average time to restore equipment, subsystems, systems to full functionality.

1.1.35 "Notice" means a Notice of No Objection.

1.1.36 "Other Contractor" means the contractor(s) other than the Signalling and Telecommunication Contractor.

1.1.37 "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.

1.1.38 "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.

1.1.39 "Operating Hours" means operating hours for Train Operation in HORC shall be 24 Hours all days.

1.1.40 "Particular Specifications" means the Specifications prepared for the purpose as enclosed in PS(Signalling) and PS(Telecommunication).

1.1.41 "Permanent Work" means the permanent works to be designed and executed by the Contractor under the Scope of Work covered in this Contract.

1.1.42 "Preliminary Design" means the submission of Contractor's Documents which comprise the initial stage of the design phase. It is basically a concept scheme design.

1.1.43 "Preliminary Drawings" means the drawings prepared by the Contractor that are built on the Reference Drawings and accompany the Contractor's Preliminary Design submissions.

1.1.44 "Pull-down Menu" means a list of items displayed by clicking mouse, arranged in the downward direction.

1.1.45 "Pull-up Menu" means a list of items displayed by clicking mouse, arranged in the upward direction.

1.1.46 "Possession" means taking a section of the line out of service for engineering purposes.

1.1.47 "Railway" means Railway or any portion of a Railway for public carriage of passengers and goods including dedicated freight corridors.

1.1.48 "Railway Envelope" means the zone or zones which contain the track, platforms and equipment necessary for the operation of the Railway by the HRIDC.

1.1.49 "Reference Drawings" means the drawings prepared by the Employer and included in the bidding document.

1.1.50 "Reliability" The probability that an item/equipment/system can perform a required function under given conditions for a given time interval. The measure of reliability is MTBF.

1.1.51 "Reliability growth" condition characterised by a progressive improvement of a reliability performance measure of an item with time.

1.1.52 "Right of Way" means the width/area of the land acquired/being acquired for the operation of the HORC Project.

1.1.53 "Safety" freedom from unacceptable risk of harm.

1.1.54 "Safety Integrity Level": One of a number of defined 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.

1.1.55 "Safety-Critical" means failure of the system, sub-system or equipment that directly leads to a situation with the potential to cause harm, injury, damage to property, plant or equipment, damage to the environment, or economic loss.

1.1.56 "Site" means the area where the Permanent Works are executed in the Right of Way or adjoining the Right of Way.

1.1.57 "Sub-system": Each system comprises of sub systems. Signalling System comprises sub systems of Electronic Interlocking System, Train Detection System, Point Operation System, Absolute Block Working with BPAC, Power Supply System, Remote Diagnostic and Predictive system etc. Telecommunication System comprises of sub systems of Optical Fiber Communication System, Quad cable communication system, Telephone System, Emergency Communication System, VHF Communication System, Digital clock with GPS synchronization by Master clock system, Public address System for passenger trains and Power supply System etc.

1.1.58 "Stations" means Junction Stations, Crossing Stations of HORC and connected IR stations .

1.1.59 "System Acceptance Tests" means those tests that demonstrate the performance of the installation/equipment to the specified requirements as detailed in the Particular Specifications.

1.1.60 "Particular 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, construction/Installation, testing and commissioning which are developed during the Design Phase and fully comply with the Employer's requirements.

1.1.61 "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.

1.1.62 "Train Operator/Driver" means the person on the train responsible for its operation.

1.1.63 "Validation": Confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use have been fulfilled.

1.1.64 "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.

1.1.65 "Workstation" means the collection of processors, screens and input devices necessary to provide one controller or maintenance personnel with necessary system displays and commands.

1.1.66 "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.

1.1.67 Employer's name and address: Haryana Rail Infrastructure Development Corporation Limited (HRIDC), Plot No 143, 5th Floor, Railtel Tower, Sector-44, Gurugram, Haryana-122003, E-mail: gmphridc@gmail.com

1.1.68 Engineer's name and address: RITES Limited in Consortium with SMEC International Pty Ltd, 4th Floor, Plot No.144, RITES Limited, Sector-44, Gurugram, Haryana-122003

1.1 ABBREVIATIONS

ALARP	As Low As Reasonably Practicable
ACO	Automatic Change over
BGP	Border Gateway Protocol
BPAC	Block proving with axle counter
BS	British Standards
CAD	Computer Aided Design
CD	Compact Disc
CENELEC	European Committee for Electro Technical Standards (Comité Européen de Normalisation Electro technique).
CIP	Co-ordinated Installation Plan
CIU	Central Interlocking Unit
CLS	Colour Light Signal
CRS	Commissioner for Railway Safety
CSD	Combined Service Drawings
CST	Civil, Structure and Track
CTC	Centralised Traffic Control
CTR	Cable Termination Rack
CV	Curriculum-Vitae
DAC	Digital Axle Counter
DC	Direct Current
DDF	Digital Distribution Frame
DFC	Dedicated freight corridor
DHCP	Dynamic Host Configuration Protocol
DID	Direct Inward Dial
DL	Double Line
DLP	Defect Liability Period
DLT	Direct Line Telephone
DN	Down Direction
DNP	Defect Notification Period
DOT	Department of Telecom, Government of India
DOD	Direct Outward Dial
DP	Detection point
DRC	Design Requirement Criteria
DT	Down Time
DTMF	Dual Tone Multiple Frequencies (Signalling)
DTN	Data Transmission Network
DVT	Design Verification Table
DWC	Double Wall Corrugated
EIRENE	European Integrated Railway Radio Enhanced Network
E-LAN	Ethernet Local Area Network

EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
EMP	Environmental Management Plan
E&M	Electrical & Mechanical
EN	European Norm
EoMPLS	Ethernet over MPLS
EoS	Ethernet over SDH
EPL	Ethernet Private Line
ERP	Enterprise Resource Planning
ESHS	Environment, Social, Health and Safety
ETSI	European Telecommunication Standards Institute
EVPL	Ethernet Virtual Private Line
FAT	Factory Acceptance Tests
FMECA	Failure Modes Effect and Criticality Analysis
FRACAS	Failure Report And Corrective Action System
FRS	Functional Requirement Specifications
FTA	Fault Tree Analysis
GCR	Group Call Register
GOS	Grade Of Service
GPS	Global Positioning System
GS	General Specifications
GSM-R	Global System for Mobile communication — Railway
HCS	Hundred Call Seconds
HDPE	High Density Polyethylene
HORC	Haryana Orbital Rail Corridor
HSRP	Hot Standby Router Protocol
HT	High Tension
HTML	Hyper Text Markup Language
Hz	Hertz
ID	Identification
ICD	Interface Co-ordination Document
IEC	International Electro — technical Commission
IEEE	Institute of Electrical and Electronics Engineers
IGMP	Internet Group Management Protocol
IHA	Interface Hazard Analysis
IMD	Integrated Maintenance Depot
IMSD	Integrated Maintenance Sub-Depot
IMP	Interface Management Plan
IOT	Inter-Operability Test
IP	Internet Protocol
IR	Indian Railways
IPMPLS	Internet Protocol Multi-Protocol Label Switching

IRS	Indian Railway Standards
IRSEM	Indian Railway Signal Engineering Manual
ISDN	Integrated Services Digital Network
lSIS	Intermediate System to Intermediate System
ISO	International Standards Organisation
IT	Information Technology
ITU-T	International Telecommunications Union — Telecommunication Standardization Sector
Km / KM	Kilo Meter
KV	Kilo Volt
KMPH	Kilo Meter Per Hour
LAN	Local Area Network
LC	Level Crossing
LCD	Liquid Cristal Display
LDP	Label Distribution Protocol
LED	Light-Emitting Diode
LRU	Line Replaceable Units
LT	Low Tension
L2PT	Layer 2 Protocol Tunnelling
MCIL	Maintainability Critical Items List
MDF	Main Distribution Frame
MMI	Man Machine Interface
MPLS	Multi-Protocol Label Switching
MSC	Mobile Switching Centre
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
MTTR	Mean Time To Restore
MTBSAF	Mean Time Between Service Affecting Failure
NMS	Network Management System
NOC	No Objection Certificate
NR	Northern Railway
NTP	Network Time Protocol
O&M	Operation and Maintenance
ODBC	Open Data Base Connectivity
ODF	Optical Distribution Frame
OEM	Original Equipment Manufacturer
OFC	Optical Fiber Cable
OHE	Overhead Equipment
OHTL	Over Head Transmission Lines
OSPF	Open Shortest Path First
O&SHA	Operating and Support Hazard Analysis
PBX	Private Branch Exchange
PCM	Pulse Code Modulation

PDH	Piesio-chronous Digital Hierarchy
PIJF	Paper Insulated Jelly Filled
PMIS	Project Management Information System
PHA	Preliminary Hazard Analysis
POP	Point of Presence
PS	Particular Specifications
PSTN	Public Switched Telephone Network
PTT	Press To Talk
OPM	Other Preventive Measures
QA	Quality Assurance
QoS	Quality of Service
RA	Remote Access
RAMS	Reliability, Availability, Maintainability and Safety
RBD	Reliability Block Diagram
RDT	Reliability Demonstration Testing
RCIL	Reliability Critical Item List
RDC	Radio Dispatcher Console
RDSO	Research Design and Standards Organization
REC	Railway Emergency Call
RF	Radio Frequency
RFO	Rail Flyover
RH	Relative Humidity
ROB	Road Over Bridge
ROW	Right Of Way
RSI	Repetitive Strain Injury
RUB	Rail Under Bridge
SC	Station Controller
SCC	Section control centre
SCADA	Supervisory Control and Data Acquisition
SCIL	Safety Critical Items List
SCR	Station Controller Room
SDH	Synchronous Digital Hierarchy
SAT	System Acceptance Tests
SCADA	Supervisory Control and Data Acquisition
SCC	Sectional control centre
SER	Signalling Equipment Room
SINAD	Signal to Noise And Distortion Ratio
SIL	Safety Integrity Level
SL	Single Line
SM	Station Master
SM	Single Mode
SMSC	Short Message Service Centre
SNCP	Sub-Network Connection Protection

SOD	Schedule of Dimension
SP	Sectioning Post
SRS	System Requirement Specifications
SSP	Sub-Sectioning Post
SSHA	Subsystem Hazard Analysis
S&T	Signalling & Telecommunication
STM	Synchronous Transport Module
SWR	Station Working Rules
TCAS	Train Collision Avoidance System
TCP/IP	Transmission Control Protocol / Internet Protocol
TDM	Time Division Multiplexing
TER	Telecommunication Equipment Room
TLC	Traction Loco Controller
TMN	Telecommunications Management Network
T-LDP	Targeted Label Distribution Protocol
TPC	Traction power controller
TRAU	Trans-coder Rate Adaption Unit
TRX	Transceiver
TSS	Traction sub station
UPS	Uninterruptible Power Supply
UPSR	Uni-directional Path Switched Ring
UTC	Universal Time Co-ordinate
VAT	Value Added Tax
VC	Virtual Container
VDU	Video Display Unit
VHF	Very High Frequency
VMS	Voice Mail System
VPN	Virtual Private Network
VRS	Voice Recording System
VF	Voice Frequency
VHF	Very High Frequency
VoIP	Voice over IP
VLAN	Virtual Local Area Network
VLR	Visitor Location Register
VPWS	Virtual Private Wire Services
VRLA	Valve Regulated Lead Acid
WAN	Wide Area Network
WPC	Wireless Planning Coordination Committee

1.3 PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHTS

1.3.1 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 in 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.

1.3.2 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 the Signalling & Telecommunication system and 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

1.4 CLASSIFICATION OF EQUIPMENT ENVIRONMENT

1.4.1 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, as defined in TEC QM-333 2010 (Latest) (tec.gov.in) standard for environmental testing of equipment

CLASS	LOCATION OF EQUIPMENT
A	Air-Conditioned Center/Offices and Equipment Rooms. Air-conditioning failure of less than 2 hours duration at a time is permissible.
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 ventilationmay or may not be available.
C	Buried underground or installed in manholes.
D	Outdoors — Location boxes, Cabinets or Containers, DP's protected from direct sunlight without any ventilation.

1.4.2 All equipment shall be designed and tested in accordance with the given figures allowing a margin of at least 10% greater and 2°C less than the limits recorded. 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.

Requirements for Class A	
Storage Temperature	-5-60°C
Ambient Temperature	0-35°C

Maximum Temperature	35°C
Relative Humidity	Minimum 0%, Nominal 65%, Maximum 95% (Non Condensing)
Electrical Noise	High Frequency to 1MHz, 1 kV damped to 50% after 6 cycles. Radio Frequency strength 10V/m, UHF & VHF bands.
Requirements for Class B	
Ambient Temperature	30°C
Maximum Temperature	45°C
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, 500 Ω source impedance, 0.5J source energy. Radio & High Frequency as Class A.
Requirements for Class C	
Ambient Temperature	46°C
Maximum Temperature	60°C
Electrical Noise	Impulse 5kV, otherwise as Class B
Requirements for Class D	
Temperature	all equipment shall be designed and tested in accordance with the given figured allowing a margin of at least 10% greater and 2^o C less than the limits recorded. All designs for equipment shall work within the enclosures proposed with the specified environment outside the enclosure; particular attention shall be paid to the possibility to solar gain as referred to following.

Daily maximum and minimum temperature during winter, summer and rainy season (ever recorded):

	Max	Min
Winter (November to February)	35° C	-0.6° C
Summer (March to June)	47.2° C	4.4° C
Rainy (July to October)	45° C	9.4° C

Monthly average maximum and minimum temperature during winter, summer and rainy season:

Winter				
	Nov	Dec	Jan	Feb
	°C	°C	°C	°C
Max:	28.7	23.4	21.3	23.6
Min:	11.8	8.0	7.3	10.10
Summer				
	March	Apr	May	June
	°C	°C	°C	°C
Max:	30.2	36.2	40.5	39.9
Min:	15.1	21	26.6	28.7
Rainy				
	Jul	Aug	Sep	Oct

	°C	°C	°C	°C
Max:	35.3	33.7	34.1	33.1
Min:	27.2	26.1	24.6	18.7

Maximum recorded daily total rainfall per 24 hrs:	495.3 mm (1875)

Monthly average total rain fall (during rainy season)

June	July	August	September
62.2 mm	203.2mm	202.2mm	137.6mm

Wind Pressure	The system is designed to give satisfactory service for a wind pressure up to 150 kgf/m^2
Sunshine	Monthly average sunshine hours can be obtained by placing a specific request to Meteorological Department.
Relative Humidity	Daily maximum and minimum average values during winter, summer and rainy season.

	Max	Min
Winter	72%	28%
Summer	48%	16%
Rainy	77%	35%

(End of Chapter-1)

CHAPTER 2- PROJECT PROGRAMME REQUIREMENT

2.1 GENERAL REQUIREMENTS

2.1.1 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 programmes which reflect the detailed planning undertaken.

2.1.2 The Programmes 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.

2.1.3 The Programme 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.

2.1.4 Milestones shall be an integral part of all programmes 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 programme logic. Milestones shall not be introduced into any programme as constrained dates.

2.1.5 The critical path shall be clearly identified in the programme and shall be fully described in the accompanying programme narrative.

2.1.6 Activity descriptions shall clearly convey the nature and scope of the Works. Programmes 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.

2.1.7 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.

2.1.8 The Contractor shall monitor its and its subcontractor's performance against programmes 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 computerised 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.

2.2 THE EXECUTION PHASES

The execution activity will include various phases of the implementation as under:

- Design Phase
- Manufacturing/Supply Phase
- Construction/Installation Phase
- Testing & Commissioning Phase and
- Operation & Maintenance Phase

2.2.1 Design Phase: The contractor shall deploy a qualified team of the Design Engineers

and Experts as approved by the Employer, evidencing the experience of the design in relevant field and technology with the approval of the Engineer, before commencement of Design Phase. The Design Phase shall have 4 stages as detailed below:

2.2.1.1 Preliminary Design

2.2.1.2 Detailed Design

2.2.1.3 Construction / Installation Design

2.2.1.4 As Built Drawings & Documents

2.2.2 Manufacturing /Supply Phase: The manufacturing /supply will constitute the following:

2.2.2.1 Manufacturing/Procurement;

2.2.2.2 Factory Acceptance Tests (FAT);

2.2.2.3 Delivery to the contractor's stores at site; and

2.2.2.4 Storage at the site Stores, including establishing the Material Procurement tracking, receipt and issue procedures.

2.2.3 Construction/ Installation Phase: Construction/ Installation Phase will constitute of the following:

2.2.3.1 Site Management including access/ ROW preparation;

2.2.3.2 Availability of Construction reference Drawings;

2.2.3.3 Installation preparatory works like Foundations, first fix, site safety and quality assurance procedures etc.;

2.2.3.4 Equipment installation; and

2.2.3.5 Training of Employer's Personnel

2.2.4 Testing and Commissioning Phase: Testing and commissioning phase will constitute of the following:

2.2.4.1 Testing and Commissioning of all subsystems.

2.2.4.2 Quality assurance.

2.2.4.3 Integrated Testing & Commissioning.

2.2.4.4 Trial run including service trials; and

2.2.4.5 Submission of verified As Built Drawings & Documents

2.2.5 Operation and Maintenance Phase: Operation and Maintenance Phase will constitute of the following but not limited to:

2.2.5.1 Operation and Maintenance activity

2.2.5.2 Defect rectification

2.2.5.3 Workshop Repair Services

2.2.5.4 Support and Call Out Services

2.2.5.5 RAMS demonstration

2.2.5.6 Supply of O & M Manuals, Maintenance schedules etc.

2.3 WORKS PROGRAMME

2.3.1 The Works Programme to be submitted under the contract shall be developed from the Outline Works Programme submitted and developed during the Bid period according to Key Dates given in the Bid documents.**Within 30 days** of the Commencement Date of the Works the Contractor shall submit for review by the Engineer, his proposed initial version of the Works Programme which shall provide full programme details for the first six months of the contract and shall provide outline details for the remaining period of the contract.

2.3.2 **Within 60 days** of the Commencement Date of the Works, the Contractor shall submit the proposed full version of the Works Programme for review by the Engineer

2.3.3 The Works Programme shall demonstrate by reference to its Sub Programmes, Supplementary Programmes and Associated Management Plans, the sequence and duration of the activities and any restraints there to that the Contractor shall adopt to achieve Milestones and to fulfill all Contract obligations. The Works Programme shall become the basis of administration of the time-related aspects of the Contract.

2.3.4 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 Programme. The number of constraints shall be kept to an absolute minimum.

2.3.5 The Works Programme shall include activities for all the phases and stages of the Works, clearly showing all logical interdependencies and stages in the development of the Contractor's design, procurement, installation, commissioning and setting to work. As a minimum, it shall include:

2.3.5.1 All works comprising the permanent works;

2.3.5.2 Preparation, submission and review of Design Documents showing all items where review by the Engineer is required. Procurement of all major materials and items of Contractor's Equipment for the Works, including the dates of orders are to be placed, manufacture period and the expected delivery date to the Site for each item

2.3.5.3 Any software development requirements and Validation time frames

2.3.5.4 All manufacture or prefabrication of materials of components

2.3.5.5 All design and installation of major Temporary Works

2.3.5.6 All activities associated with securing necessary permits and other statutory approvals for the works

2.3.5.7 Access and availability dates for all Project Contractors
2.3.5.8 All interfaces related to the project that may affect the progress of the Works
2.3.5.9 Testing and commissioning activities requirements
2.3.5.10 Training

2.3.6 The Works Programme shall be divided into Sub-Programmes of manageable size addressing in more specific detail, the content of the Management Plans. The Sub-Programme shall be as follows:

2.3.6.1 Design Submission Programme

2.3.6.2 Procurement and Manufacturing Programme
2.3.6.3 Installation Programme
2.3.6.4 Testing and Commissioning Programme
2.3.6.5 Training Programme
2.3.6.6 Maintenance Programme

2.3.7 The submission of the full version of the Works Programme shall include the Design Programme, Procurement and Manufacturing Programme, Preliminary version of the Installation Programme and the Testing and Commissioning Programme identifying all major installation, testing activities and associated interfaces

2.3.8 The Sub-Programmes shall be further substantiated by the supplementary programmes as required by the Engineer

2.3.9 The Contractor's Works Programme (CPM) shall comply with the following:
2.3.9.1 All programmes shall be submitted in both the Hard copy and Electronic data format

2.3.9.2 All programmes shall be prepared using the latest version of CPM scheduling software Primavera Project Planner or similar

2.3.9.3 A standard Gregorian calendar shall be used for planning and execution of the Works. All Programme 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 nonwork day it shall be effective on the next working day.

2.3.9.4 The planning unit for the duration of all programme activities shall be "day". Any activity having a duration of more than thirty (30) days shall be divided into sub activities that shall not exceed thirty days.

2.3.9.5 CPM programmes shall reflect status using remaining duration and percent complete.

2.3.10 All programmes 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:
2.3.10.1 Major manpower for both Design and Installation
2.3.10.2 Number of items of Contractor's Equipment
2.3.10.3 Number of Drawings and other Design deliverables

2.3.10.5 Principal quantities of components or parts

2.3.10.6 Principal quantities of Bulk material inclusive of Cabling, Pipe, Ductwork and Equipment item etc.

2.3.11 All Programmes constituting the Works Programme shall be organised 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 Contactor may be required to assign additional activity codes as required by the Engineer.

2.4 DESIGN SUBMISSION PROGRAMME

2.4.1 The Contractor shall, within 30 days of the Commencement Date of the Works submit a Design Submission Programme covering all proposed submissions to the Engineer. The Design Submission Programme shall be broken down into a submission programme for each of the Management Plans of which shall define the dates for individual submissions and shall confirm to the base line dates shown in the Works Programme.The Submission Programme shall include the requirements of the Design Submission including the procurement activities of all sub-contractors and suppliers.

2.4.2 The Submission Programme shall include each submission for every item listed in the specification as being required to be submitted.

2.4.3 The Submission Programme shall ensure that all submissions are properly co-ordinated with the Contractor's overall Works Programme, particularly in respect of the following:-

2.4.3.1 Progress of Design, Manufacture, Installation and Testing work;

2.4.3.2 Co-ordination with other Contractors; and

2.4.3.3 Including due allowance for the Engineer's review process to be undertaken, including the time needed for any re-submissions.

2.4.3.4 The Design Submission Programme shall specifically include a date of submission by the Contractor of the Final Design on completion of the Preliminary Design stage. The Final Design shall include following at least but not limited to;

- Details showing all of the Proposed equipment,
- Interconnections,
- Physical Layout,
- Installation Locations and
- Interfaces to other Suppliers.

2.5 PROCUREMENT AND MANUFACTURING PROGRAMME

2.5.1 **Within 60 days** of the Commencement Date of the Works, the Contractor shall submit for

review by the Engineer a Procurement and Manufacturing programme that shall be an integrated part of the overall Works programme.

2.5.2 The Procurement and Manufacturing Programme shall show the interdependencies between Engineering disciplines as well as between the Contractor and its Subcontractors and Suppliers. This programme shall demonstrate compliance with the requirements of the Submissions Programme.

2.5.3 The Procurement and Manufacturing programme shall include a separate breakdown, supported by Material Controlled Schedule, which shall be a complete amplification of the Contractor's programme 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.

2.5.4 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:

- Name, Description, Supplier/Sub-supplier details.
- Drawing information (where appropriate), title, drawing status, submission dates, shop drawings/fabrication drawing preparation etc.
- The manufacturing process, manufacturing of test pieces, trial production, Engineer inspection, monthly production of components and monthly supply of components.
- 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
- Transportation process, quality release from factory, factory storage to dock and shipment.

2.5.5 The Contractor shall continuously maintain this schedule and report upon the status of each item as part of the contractors regular progress reporting. From this based 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 indicate what action the contractor is taking to recover the lost time.

2.5.6 The Contractor shall submit, as part of the Procurement and Manufacturing Programme, a Factory Testing programme that shall support all aspects of the Factory Testing Plan.

2.5.7 The Factory Testing programme 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.

2.5.8 The Factory Testing programme shall demonstrate the logical dependencies between the individual tests of the works and shall also show the interfaces and dependencies with the contractors delivery programme.

2.5.9 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:

- First article inspection;
- Quality Hold Points;
- Quality Control Points;
- Type Tests; and
- Routine Tests.

2.6 INSTALLATION PROGRAM

2.6.1 The Installation Programme shall be submitted as stated in the PS or as directed by the Engineer. The Installation Programme shall comply with the requirements of clause 2.3.10 above.

2.6.2 The Installation Programme 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 and Manufacturing Programme and Testing and Commissioning Programme to form an integrated part of the Works Programme.

2.6.3 The Installation Programme shall be fully supported by the Construction and Installation Management Plan.

2.6.4 The Installation Programme 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.

2.6.5 The Installation Programme 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.

2.6.6 Installation tests shall be clearly shown in the Installation Programme and shall include those interface tests required to be carried out by others to establish a time table for these tests.

2.6.7 Activities that may be expedited by the use of overtime, additional shifts or by any other means shall be identified and explained.

2.6.8 In preparing the Installation Programme, the contractor should note that the following conditions shall apply:

2.6.8.1 The Contractor shall not have exclusive access to any part of the site except by the specific consent of Engineer.

2.6.8.2 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.

2.6.8.3 The absence of a programme date or installation period for the contractor in a specific area shall not prejudice the right of the Engineer to establish a reasonable programme date or installation period for that area.

2.6.8.4 The Contractor shall comply with the identified Milestone Dates identified in the contract.

2.7 TESTING AND COMMISSIONING PROGRAMME

2.7.1 The Testing and Commissioning Programme shall be submitted as stated in the PS or as directed by the Engineer and shall comply with the requirements of the clause 2.3.10 above.

2.7.2 The Contractor shall submit the Testing and Commissioning Programme that shall fulfill all the On-site testing and commissioning requirements. The Testing and Commissioning Programme shall clearly demonstrate the logic and highlight topics listed in the On-Site Testing and Commissioning Plan.

2.7.2 The Testing and Commissioning Programme 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.

2.7.3 The Testing and Commissioning Programme 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.

2.8 TRAINING PROGRAMME

2.8.1 The Contractor shall within **120 days** of the Commencement Date of the Works submit for review by the Engineer a Training Programme covering all proposed formal training courses, delivery of training equipment and accesses by the Employer's personnel.

2.8.2 The Training Programme shall be developed to the Training Plan as required.

2.8.3 The Training Programme shall be sufficiently detailed that the Employer can ensure the availability of staff for all the courses.

2.8.4 The Training Programme shall include the requirements of the Training activities of all sub-contractors and suppliers given in PS/ Signalling and PS/ Telecommunications.

2.9 MAINTENANCE PROGRAMME

2.9.1 The Contractor shall within **120 days of** the Commencement Date of the Works submit for review by the Engineer, a Maintenance Programme covering all proposed maintenance activities during DLP period and Maintenance period.

(End of Chapter-2)

CHAPTER 3 — MANAGEMENT PLANS AND SUBMISSIONS

3.1 GENERAL

3.1.1 In order to ensure that the Contractor understands and complies with the requirements of the Contract, a series of Management Plan shall be developed. These Management Plans will serve to structure the submittals in a manner that the Contractor can develop and prepare the submittals and the Engineer can review and comment on a prescribed programme.

3.1.2 The Management Plans shall be configured as a family of "stand-alone" plans and associated documents, each covering one of the subjects listed below.

3.1.3 The plans and documents shall be co-ordinated with each other and shall collectively define, describe and encompass the Contractor's proposed methods, procedures, processes, organisation, sequencing of activities etc. and shall show how these combine together to assure that the work truly meets the requirements of the specifications in respect of the subject listed.

3.1.4 Unless otherwise stated in the PS, all plans and documents shall be submitted in preliminary form within **60 days** of the Commencement Date of the Works followed by detailed plan **within 45 days** of the preliminary submission. Further submissions shall be made:

- When required in accordance with the Works Programme
- Whenever the development of the Contractor's designs or planning allows the plan to be developed further
- In response to comments made by the Engineer
- Whenever any change occurs that invalidates the information contained in the previously submitted and reviewed document, within 14 days of the occurrence of such change; and
- When requested by the Engineer from time to time.

3.2 GEERAL ORGANISATION

The plans listed below shall be developed and submitted by the Contractor for the Engineer's review:

1) Project Management Plan
   - Contractor's Project Plan
   - Interface Management Plan
2) Systems Assurance Plan
   - Quality Plans
   - RAMS Plan

- Electromagnetic Compatibility Management Plan
- Software Quality Assurance Plan

3) Design, Procurement and Manufacturing Management Plan
   - Design Plan
   - Design Verification and Validation Plan
   - Procurement, Manufacturing and Delivery Plan
   - Factory Testing Plan
4) Construction and Installation Management Plan
5) Completion Management Plan
   - Commissioning Plan
   - Training Plan
   - Spares Management Plan
   - Operational and Maintenance Manuals Plan
   - Defects Liability Management Plan
   - Maintenance Plan

3.3 PROJECT MANAGEMENT PLAN

The overall management of the Works shall be the Contractor's responsibility. The organisation of the resources for the Design, Procurement, Manufacture, Delivery, Installation, Testing and Commissioning, and setting to work is to be 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. The Contractor shall co-ordinate its interface requirements with Employer and Other Interfacing Contractor(s), which Employer may engage from time to time, in such a manner so as to minimize disruption to any party arising from such concurrent work.

3.3.1 Contractor's Project Plan

3.3.1.1 The Contractor's Project Plan shall provide a clear overview of the Contractor's organisation, management systems and methods to be used for complete execution of the Works.

3.3.1.2 The Contractor's Project Plan shall include a summary description of each and every stage of implementation of the Works, clearly showing the principal organisational interfaces both within the Contractor's own organisation (including sub-contractors of every tier) and with Other Contractors and Relevant Authorities, defining how each of these interfaces is to be managed and controlled. An organisation chart shall be produced to illustrate the subdivision of the work into elements for effective technical and managerial control, the reporting structure and the interface relationship among all parties involved.

Names, addresses, telephone and fax numbers of all principal contacts shall be listed.

3.3.1.3 The Contractor's Project Plan shall contain structured organisation charts showing the hierarchical relationship of the Contractor's organisation (including sub-contractors of every tier). The organisation charts shall be produced as a "family" such that the basic chart shows the overall organisation structure supported by subsidiary charts detailing the internal structure of various departments or sections of the overall organisation.

3.3.1.4 The Contractor's Project Plan shall include full details of the qualifications, experience, authority and responsibility of the personnel assigned to all key positions of the Contractor's organisation (including sub-contractors of every tier). As a minimum, this shall include all levels down to senior managers and shall include the personnel responsible for each individual department and functional group. A clear reference shall be given as to the location of staff (e.g. site resident or factory based, etc). Names, addresses, telephone and fax numbers of all principle contacts shall be listed.

3.3.1.5 The Contractor's Project 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:

3.3.1.5.1 The procedure for audit.

3.3.1.5.2 The procedures for the control of receipt and issue of all Works related correspondence so as to ensure traceability;

3.3.1.5.3 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 as for as is necessary;

3.3.1.5.4 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;

3.3.1.5.5 the procedures for the evaluation, selection, engagement and monitoring of sub-contractor/suppliers together with the means of application of quality assurance to their work including audit and acceptance;

3.3.1.5.6 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 methods to be used for revision and issue of revised documentation;

3.3.1.5.7 the procedures for the control, calibration and maintenance of inspection, testing and measuring equipment;

3.3.1.5.8 the procedures for the selection, indexing, disposition and maintenance of project record 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;

3.3.1.5.9 the procedures for identifying training needs and for the provision of training of all personnel performing activities affecting quality; and

3.3.1.5.10 the procedures for the control of non-conformity.

3.3.1.6 The Contractor's Project Plan shall include details of Contractor's Main Site Office and other Site Office(s) to be located throughout HORC Section.

3.3.2 Interface Management Plan (IMP):

3.3.2.1 General

3.3.2.1.1 Co-ordination responsibilities of Contractor shall include, but not be limited to following:

- Provision of all information reasonably required by the interfacing parties in a timely and professional manner so as to allow them to proceed with their design or construction activities and enable them to meet their contractual obligations.
- Assurance that the interfacing parties' requirements are provided to all concerned interfacing parties in time providing them ample opportunity to do their part of requirement for interfacing.
- Receipt from interfacing parties of such information as is reasonably required to enable Contractor to meet design submission schedule as identified in Design Requirements given in this document.
- Assurance, copies of all the correspondence, drawings, minutes of meeting, programs, etc. relating to the Contractor's co-ordination with the interfacing parties shall be issued to all concerned parties and four (4) copies issued to the Engineer no later than fourteen (14) calendar days from the date of such correspondence and meetings.

3.3.2.1.2 The Contractor shall provide sufficient information to the Engineer to decide on any disagreement between Contractor and interfacing parties as to extent of services or information required to exchange. If such disagreement can not be resolved by Contractor despite having taken all reasonable efforts, the decision of the Engineer shall be final and binding on the Contractor(s).

3.3.2.1.3 Where an interfacing contract is yet to be awarded, the Contractor shall proceed with co-ordination activities with Engineer until such time as interfacing contractor is appointed.

3.3.2.1.4 The Contractor shall note that information exchange is an iterative process requiring exchange and updating of information at 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.

3.3.2.1.5 The Contractor shall co-ordinate with 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.

3.3.2.1.6 The 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.

3.3.2.1.7 The Contractor shall prepare an IMP which shall identify the interface manager, the structure and responsibilities of interface management team and procedures that will be implemented to identify and close out all interfaces.

3.3.2.2 Interface Management Plan shall:

3.3.2.2.1 Identify the sub-systems as well as works and facilities with interfacing requirements.

3.3.2.2.2 Define authority and responsibility of Contractors and all other contractors (and any

relevant sub-contractors') staff involved in interface management and development.

3.3.2.2.3 Identify information to be exchanged, precise division of responsibility between the Contractor and other contractor(s) and integrated tests to be performed at each phase of Contractor's and other contractors' works.

3.3.2.2.4 Address Works Program of Contract to meet milestones of each contractor and highlight any program risks requiring the Employer's attention keeping in view timeline of Contract.

3.3.2.2.5 Address the interface issues during Design and Construction.

3.3.2.2.6 Interface management table has been attached as Appendix-10 for reference.

3.3.2.2.7 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).

3.3.2.2.8 The timescale for resolving interfaces shall be set down in Co-ordinated Interface Document (CIP) and with the each Other Interfacing Contractor(s).

3.3.2.3 Design Interface:

- The Contractor shall commence the design interface with the interfacing contractor of Civitl, Track, Bridge, Electrical and other packages of HORC project as soon as he has been notified by the Engineer that an interfacing contract has been awarded.
- The Contractor shall, immediately upon award of the Contract, gather all necessary information and develop his design to a level where meaningful interaction can take place.
- The Contractor shall submit together, with each of his Design submissions a joint statement from Contractor and the relevant interfacing contractor 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.
- The Design interface is an iterative process requiring regular exchange and update of interfacing information and 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.

3.3.2.4 Construction/ Installation Interface:

- 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.
- 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.

3.3.2.5 Employer's/ Engineer's Input: 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. The Employer/Engineer, within the scope of the relevant Contract provisions, will support and assist the Contractor in the following fields:

3.3.2.5.1 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;

3.3.2.5.2 Interfacing with State and local authorities for implementation of the additional land acquisition procedures;

3.3.2.5.3 Any other fields of activities related to the Contract as may be required with the purpose of facilitating the Contractor's performance.

3.3.2.5.4 This support and assistance of the Employer/ Engineer shall not absolve the Contractor of any of his obligations under this Contract.

3.3.2.6 Interface Management

- The Contractor shall create, in co-ordination with the other contractors, a Co-ordinated Interface Document (CID) for each interface, which shall be signed by all the parties involved.
- 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.
- The Contractor shall co-ordinate all interface items on the list and agreed solutions with the other contractors.
- An indicative interface management table has been attached at Appendix-11.

3.3.2.7 Dedicated Co-ordination Team

- The Contractor shall establish a dedicated co-ordination team led by a coordinator reporting to the Contractor's Project Manager.
- The primary function of the team is to provide a vital link between the Contractor's design and manufacturing teams and the interfacing parties. The Contractor shall provide the Engineer with the particulars of the coordinator.
- The Engineer shall have the right to direct the replacement of the coordinator if in his opinion the coordinator is unable to meet the co-ordination requirements of the Contract.
- The Contractor's attention is drawn to the need for the coordinator to establish effective dialogues and communication links among the 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.

- The coordinator shall assess the progress of co-ordination with interfacing contractors by establishing lines of communications and promoting regular exchange and updating of information so as to maintain the Contractor's program.
- 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 minimise the effects of potential delays.
- The coordinator in conjunction with all interfacing contractors shall identify necessary provisions in the Works for plant, equipment and facilities of these contractors. These provisions shall be allowed by the Contractor in his design of the Works.

3.3.2.8 Co-ordination with other Contractors and Indian Railways:

3.3.2.8.1 The Contractor shall undertake Design co-ordination with other contractor(s) and Indian Railways.

3.3.2.8.2 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.

3.3.2.8.3 **Design co-ordination** shall include, but not be limited to, the following:

3.3.2.8.3.1 Definition and agreement with other contractors of interface areas and contract limits;

3.3.2.8.3.2 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;

3.3.2.8.3.3 Agreement of combined service drawings and structural opening drawings.

3.3.2.8.3.4 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.

3.3.2.8.3.5 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.

3.3.2.8.3.6 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.

3.3.2.8.3.7 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.

3.3.2.8.3.8 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.

3.3.2.8.3.9 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.

3.3.2.8.3.10 Any additional cost arising to the Contractor due to his late and/or improper interfacing with the other contractor(s) 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.

3.4 SYSTEM ASSURANCE PLANS

3.4.1 General:

3.4.1.1 The Systems Assurance Plans shall be submitted for review to the Engineer in Preliminary and Final forms.

3.4.1.2 Various plans shall be co-ordinated 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 specifications in respect of the subjects listed.

3.4.2 Quality Plans: The Contractor shall submit for review by the Engineer quality plans in accordance with the requirements of Chapter-6.

3.4.3 RAMS Plans:

3.4.3.1 The Contractor shall implement a formal Reliability Plan and a formal Maintainability Plan in accordance with the PS.

3.4.3.2 The Contractor shall submit the Contractor's Reliability Plan and Maintainability Plan in accordance with the requirements of the Chapter-7 for review to the Engineer. The Contractor's Reliability Plan and a Maintainability Plan shall include Failure Modes, Effects and Criticality Analysis and the production of a Reliability Critical Items List.

3.4.3.3 The contractor shall submit for review by the Engineer the Contractor's Systems Safety Plan. The Systems Safety Plan shall address all the factors referenced in this Specification and as required by the PS.

3.4.4 **Electromagnetic Compatibility Management Plan:**

3.4.4.1 The Contractor shall prepare and submit for review by the Engineer, EMC Management Plan which shall, based upon a top-down approach, define the EMC philosophy, activities, means of control for the design processes and EMC submissions to be supplied to demonstrate compliance with the PS and GS.

3.4.4.2 The EMC Management Plan shall identify a comprehensive list of specifications, standards, method statements and procedures to be submitted to the Engineer for review. The EMC Management Plan shall also include a programme that shall identify the dates for EMC submissions.

3.4.4.3 The EMC Management Plan shall include an initial list of Design documentation, Test specifications, Land test reports with a single paragraph description of each document to indicate compliance with the Specification.

3.4.4.4 The EMC 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 aspects.

3.4.4.5 The Contractor shall co-ordinate 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. 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 Representative.

3.4.4.6 The Contractor shall liase and co-ordinate with all other Contractors in the exchange of EMC data a related equipment performance characteristics and advises the Employer's Representative when any such information is requested from any other Contractor. A copy of all EMC related information exchange shall be sent to the Employer's Representative for review.

3.4.4.7 The Contractor shall comply with the following EMC requirements:

- 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.
- EMC considerations shall be incorporated in the Contractor's procedures for product safety and design Verification.
- The design shall ensure that any electromagnetic interference emissions introduced

into the environment do not exceed those detailed in the PS and GS. The Contractor shall ensure that the specified electromagnetic compatibility (EMC) requirements are adequate. Any shortcomings shall be made known to the Employer's Representative immediately and recommendations for corrective action formulated.

- In respect of the design documentation, the Contractor shall demonstrate by theoretical analysis that the design of 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.
- The Contractor shall detail the methodology used in support of the analysis. Contractor shall prepare and submit to the Engineer for review reports of the validation of the models.
- The Contractor shall supply documentation showing how system safety and reliability is ensured. It shall include Failure Mode, System Failure, the effect of human intervention, how equipment has failed thresholds that have been set in order to keep them above worst case interference levels, and how equipment tolerances and other characteristics in the Specifications have been allowed for in designing the system.
- The Engineer may conduct an independent EMC audit for both the systems 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.
- The Engineer may request at his discretion, attendance at the manufacturing factory prior to delivery to assist in providing confidence that the EMC requirement will be met. However, this will not give design acceptance that can only be given after successful completion of the System Acceptance Tests.
- The Contractor shall implement corrective actions to rectify any EMC problem identified during design, On-Site testing and when the whole system is in operational service.
- The Contractor must be fully aware of the EMC requirements and any modifications to the systems and equipment carried out by the Contractor during the Defect Notification Period shall not cause the immunity or emission levels of the installed systems and equipment to exceed such values. Detailed EMC documentation on all modifications carried out shall be submitted to the Engineer for review. Modification work shall not commence until the respective submission has been reviewed without objection by the Engineer.

3.4.5 **Software Quality Assurance Plan:** Where software is a design deliverable, the Contractor shall submit a Software Quality Assurance Plan in accordance with the requirements of

Clause-9.9. The Software Quality Assurance Plan shall address all elements of the design and development of software required as part of the Works.

3.5 DESIGN, PROCUREMENT AND MANUFACTURING PLAN

The Design, Procurement and Manufacturing Plan shall be configured as a family of "stand-alone" plans and associated documents each covering one of the subjects listed below. 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 fully meet the requirements of the Specification in respect of the subjects listed below.

3.5.1 Design Plan

3.5.1.1 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 Programme.

3.5.1.2 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:

3.5.1.2.1 Preliminary Design Stage:

- The Contractor shall prepare and submit to the Engineer for his review a System Requirement Specification (SRS) which includes, as a minimum, operational, functional, performance and design requirements of the proposed system.
- The System Requirement Specification, 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.
- The System Requirement Specification shall include a compliance matrix that includes cross-references to the requirements stated in the PS, the System Requirement Specification and the Design Verification Table (DVT).
- 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.
- Further the Preliminary design stage shall address each element of the SRS as developed in the Preliminary Design. Equipment and interconnection specifications, with supporting calculation, shall be developed at this stage. Design

of the overall system and elaborating on the proposed system configuration with emphasis on how the interface requirements are to be achieved shall be included in the Preliminary design. Manufacturing of production units will only be allowed to commence after receiving a notice of no objection for the relevant design elements.

- Preliminary electrical and control schematics shall be developed to illustrate how the various operational and functional requirements can be achieved. Software design and development shall also be carried out during this stage.
- The submission shall clarify and confirm as necessary all technical aspects of all interfaces with other elements of the Contractor's overall design and of any interfaces with works being supplied by other Contractors.
- Ergonomic design shall be developed as part of the preliminary design.
- If at any time in the development of the Preliminary design, the Contractor wishes to modify the conceptual design by dividing any system or sub-system into a number of smaller systems or by reconfiguring the interfaces or for any other reason, the Contractor shall resubmit the SRS and/ or the Preliminary Design for the Engineer's review.
- A Detailed submission list for the Preliminary design shall be submitted to the Engineer for review prior to the start of the preliminary design. The submission shall be in sufficient detail to evaluate the progress and technical adequacy of the selected design approach.
- A series of Design Reviews shall be arranged prior to the conclusion of the preliminary Design Stage.

3.5.1.2.2 Detailed Design Stage: Upon completion of the Preliminary Design Stage the Contractor shall submit for review by the Engineer a homogeneous Detailed Construction / Installation Design.

3.5.1.2.3 Construction/ Installation Design Stage: Installation detail and Method statements for various areas and sections shall be released progressively during this stage. Installation works on Site will only be allowed to commence following the Engineer's review of the relevant design information with no objection raised. Separate parts of the Design plan shall be prepared for Contractor and subcontractor's design activities. The Design plans shall define the Contractor's policy for the design of the Works and shall, without limitation, define:

3.5.1.2.3.1 the organization of the Contractor's design staff with particular reference to the design interfaces;

3.5.1.2.3.2 the specific allocations of responsibility and authority given to identified design staff with particular reference to the review and Verification of design specification, drawings and calculations by the Contractor;

3.5.1.2.3.3 the specific methods of design necessary to identify any relevant method statements and develop those method statements to a sufficient degree of detail reviewed by the Engineer and

3.5.1.2.3.4 the list of procedures and work instructions to be applied to manage and control the quality of the design work, including without limitation:

- the design and performance requirements which shall be defined in terms of basic data and design assumptions made; relevant codes, standards and regulatory requirements, safety, reliability, security and environmental requirements; and commissioning requirements;
- the design methods, software applications to be used in the design, both proprietary and public domain, including any requirements for physical and mathematical model testing;
- the preparation, checking, issue, distribution, indexing and filing of reports, calculations, drawings and specifications together with the means for their revisions;
- the formal design review, authorization and approval of design documentation; and
- the independent design Verification and Validation.

3.5.2 Design Verification and Validation Plan

3.5.2.1 The Design Verification and Validation Plan, supplementary to the Design 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:-

- the objectives of each Verification phase and each Validation phase.
- defined input and output criteria for each development phase;
- identification of types and detailed methods of Test, Verification and Validation activities to be carried out;
- detailed planning of Verification and Validation activities to be carried out, including schedules, resources and approval authorities;
- selection and utilization of the test equipment, and their test environmental

conditions; and

- criteria on which the Verification or Validation is judged to be acceptable. These criteria shall be traceable to the design and performance requirements.

3.5.2.2 The Contractor shall, by means of a design Verification and Validation process, demonstrate that all requirements within the Specification have been met. The Contractor shall prepare a Design Verification Table (DVT) that identifies the Contractor's proposed methodology for demonstrating compliance.

3.5.2.3 The DVT shall be supplied to the Engineer for his review and shall be monitored throughout the design and construction of the Works. Any changes to the DVT must be submitted to the Engineer for review before implementation.

3.5.2.4 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 Specification in relation to design review, Verification, Validation, conformance or planning.

3.5.2.5 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.

3.5.2.6 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):

- Similarity — equipment and requirement are identical to those successfully applied on other projects.
- Historical — requirement has been met by numerous previous design.
- Calculations and Drawings — for review.
- Design Review — either scheduled or specifically targeted.
- Development Test — performance testing on equipment or material under development.
- Type Test — performance testing of the as-built component, assembly or system.
- Routine Test — test every component, assembly or system.
- First Article Inspection (FAI) — acceptances of the exact look and fit of equipment.
- Inspection — formal inspection of the finished item.
- In Service — for service demonstration requirements only.

3.5.2.7 After each Verification or Validation activity, a Verification Report shall be produced including, as a minimum, the following:

- The Verification or Validation results stating whether the objectives and criteria

of theDesign Verification and Validation Plan have been met; and

- The reason for failure if there is a failure, and proposal for remedial actions.

3.5.3 **Procurement, Manufacturing and Delivery Plan:** The Contractor shall prepare Procurement, Manufacturing and Delivery plans in respect of all items and goods. Separate parts of the plan shall be prepared for Contractor's or sub- contractor's 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:

3.5.3.1 the organization of the Contractor's staff directly responsible for the day-to-day management of the manufacturing activity on or off the Site;

3.5.3.2 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;

3.5.3.3 the interfacing or co-ordination required with the Contractor's other related plans;

3.5.3.4 the specific methods of manufacture to identify any relevant method statements and develop those method statements to a degree of sufficient detail reviewed by the Engineer; and

3.5.3.5 The list of procedures and work instructions to manage and control the quality of work during purchasing, manufacturing and delivery, including without limitation:

3.5.3.5.1 the purchasing of items and goods and ensuring they comply with the requirements of the Specification, Purchasing documentation and specific Verification arrangements of Engineer's inspection of material or manufactured product prior to release for use;

3.5.3.5.2 the manufacturing process so as to ensure compliance with the design;

3.5.3.5.3 the manufacturing process so as to ensure clear identification and traceability of material and manufactured parts;

3.5.3.5.4 the inspection and testing of incoming materials, in process and final product so as to ensure specified requirements for the material and/or manufactured product are met;

3.5.3.5.5 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;

3.5.3.5.6 review and disposal of non-conforming material or product so as to avoid unintended use;

3.5.3.5.7 the assessment and disposal of non-conforming material and manufactured product and approval for reworking or rejection as scrap;

3.5.3.5.8 the identification of preventive action so as to prevent recurrence of similar non-conformance; and

3.5.3.5.9 the handling, storage, packaging, preservation and delivery of manufactured product.

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

3.5.3.7 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 Engineer shall hold a formal inspection or advise that the inspection had been waived.

3.5.3.8 Once the inspection and any required remedial actions are completed to the satisfaction of the Engineer, the Engineer shall not withhold his notice of no objection for shipping unreasonably, provided all pre-delivery assembly and testing has been successfully completed.

3.5.3.9 Any unit delivered without the Engineer's notice of no objection shall be rejected at the Site and all expenses thereby shall be borne by the Contractor.

3.5.4 Factory Testing Plan:

3.5.4.1 The Contractor shall prepare and submit for review by the Engineer the Contractor's Factory Testing 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. The plan shall contain but not be limited to the following topics:

3.5.4.1.1 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

3.5.4.1.2 the sequencing and interrelationships of the inspections and tests including:

(1) First Article Inspection
(2) all Quality Hold Points; and
(3) all Quality Control Points;

3.5.4.1.3 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;

3.5.4.1.4 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;

3.5.4.1.5 organisation chart and CV of key personnel in inspection and test team;

3.5.4.1.6 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

3.5.4.1.7 Type Tests, Routine Tests, First Article Inspections and any other tests constituting the Factory Acceptance Tests.

3.5.4.2 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. Any particular requirements for inspection and testing at the place of manufacture is prescribed in the PS. Information about the place of manufacture for Signalling & Telecommunication equipment shall be submitted to the Engineer.

3.5.4.3 The Contactor shall be responsible for re-inspecting and re-testing of any failed inspection and Factory Acceptance Test including regression testing on previously passed items.

3.5.4.4 Inspections and tests that are to be witnessed by the Engineer shall be sensibly grouped and scheduled so that as many inspections and tests as possible may be witnessed during a single visit.

3.5.4.5 If required, Type Tests as detailed in relevant Particular Specifications shall be performed on all items of equipment to be installed as part of the Permanent Works under the Contract. The Type testing shall be based on the environmental class of the sites into which the equipment will be installed.

3.5.4.6 For all production items a First Article Inspection shall be undertaken. Latest drawings, inspection & test procedures, specifications and quality documentation for inspection of equipment shall be submitted for First Article Inspection to the Engineer. Routine production testing methods shall be detailed for review by the Engineer. Routine testing shall ensure that all samples of a production item are within the tolerances required for complete interchangeability.

3.5.4.7 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 Engineer. If the Engineer has witnessed the inspection or test, he will 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 Engineer has not witnessed the inspection or test (i.e. if a waiver has been granted, 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 Engineer may call for a re-inspection or re-test.

3.5.4.8 For standard equipment which is serial or bulk manufactured, manufacturer's type test certificates (or equivalent) may, subject to review by the Engineer be accepted.

3.5.4.9 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 Engineer shall be repeated afterwards.

3.5.4.10 Materials and equipment shall not be released for shipment until all applicable inspections and tests including Factory Acceptance Tests have been satisfactorily completed.

3.6 CONSTRUCTION AND INSTALLATION MANAGEMENT PLAN

The Construction and Installation Management Plan shall be configured as a family of "stand-alone" plans and associated documents each covering one of the subjects listed below. The plans shall be co-ordinated 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 ensure that the works truly meet the requirements of the Specification in respect of the subjects listed.

3.6.1 The Contractor shall prepare plans for the construction and installation activities on and off the site, as referred in Chapter-6 and shall ensure that these are properly related to the subsequent testing and commissioning activity.

3.6.2 Separate parts of the plan shall be prepared for other contractor(s) or sub-contractor(s) off-site activities.

3.6.3 Each construction plan shall identify the scope of activity to be controlled. In relation to scope of such activity, it shall, without limitation, define:

3.6.3.1 the organisation of Contractor's staff directly responsible for the day-to-day management of the activity on or off the site;

3.6.3.2 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 works;

3.6.3.3 the interfacing or co-ordination required with the Contractor's other related plans;

3.6.3.4 the specific methods of construction and installation to identify any relevant method statements to a sufficient degree of detail reviewed by the Engineer;

3.6.3.5 a detailed method statement which shall include but not be limited to;

- description of main operations and sub-operations;
- sequence of sub-operations;
- quantities of the work and production rates to be achieved;
- resources to be employed; and
- quality checks to be carried out, supervision being exercised and safety precautions to be employed;

3.6.3.6 the list of procedures and work instructions to manage and control the quality of construction and installation works, including without limitation are:

3.6.3.6.1 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;

3.6.3.6.2 the purchasing of materials and ensuring they comply with the requirement of the specification, purchasing documentation and specific verification arrangements for Engineer's inspection of material or manufactured product prior to release for use/ installation;

3.6.3.6.3 the construction processes including Temporary Works so as to ensure compliance with drawings and specification. In addition, any software to be used in construction, installation and commissioning process shall be identified and details of the Verification and validation process for the software application shall be given;

3.6.3.6.4 the construction and installation process so as to ensure clear identification and traceability of material and manufactured product;

3.6.3.6.5 the identification of the inspection and test status of all material and manufactured product during all stages of the construction and installation process to ensure that only products that have passed the inspections and tests are dispatched for use and/or installation;

3.6.3.6.6 review and disposition of non-conforming material or product so as to avoid unintended use/installation;

3.6.3.6.7 the assessment and disposition of non-conforming material and product and approval of reworking or rejection as scrap;

3.6.3.6.8 the identification of preventive action so as to prevent recurrence of similar non-conformance; and

3.6.3.6.9 The handling, storage, packaging, preservation and delivery of product; and

3.6.3.6.10 The Contractor shall prepare and submit inspection and test plans to manage and control any test and inspection activities in accordance with Chapter-7.

3.6.3.7 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 HORC properties.

3.6.3.8 The following particulars shall be submitted to the Engineer for review within 28 days of the Commencement Date of the Works;

3.6.3.8.1 drawings showing the layout within the Site of the Contractor's accommodation, project signboards, access roads and major facilities required early in the Contract;

3.6.3.8.2 drawings showing the details to be included on Project signboards.

3.6.3.8.3 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 28 days before construction of the facilities.

3.7 COMPLETION MANAGEMENT PLAN

The Contractor shall organise the services required under the Contract to bring the Works into service under one plan. This co-ordinated approach shall allow the Engineer, the ability to review all aspects of the Works and services in an integrated manner. The Completion Management Plan shall be configured as a family of "stand-

alone" plans and associated documents, each covering one of the subjects listed below. The plans shall be co-ordinated with each other and shall collectively define, describe and encompass the Contractor's proposed methods, procedures, processes, organisation, 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. Completion time shall be 180days.

3.7.1 Commissioning Plan

3.7.1.1 The Contractor shall ensure the timely preparation of the Commissioning Plan in a format and to a level of detail in accordance with clause 3.7.1.2 below. The Contractor shall submit the first draft of the Commissioning Plan to the Engineer within 180 days of the Commencement Date of the Works.

3.7.1.2 The Commissioning Plan shall consist of the following for all Signalling & Telecommunication work:

3.7.1.2.1 Installation Test Plan: The Contractor shall submit to the Engineer a comprehensive schedule of the installation Tests as required by relevant PS and in accordance with the Installation Programme. The schedule shall be submitted within the period of time laid down in the PS, or, if none is given, not later than two months in advance of the date for the commencement of the Installation Tests. Pre-Installation Inspection shall include the verification of FAT/Quality test report, Invoice, OEM manuals etc. Post installation test shall include the inspection for installation of equipment as per approved drawing, Technical specification etc. Power supply test shall be the part of Post-installation test.

3.7.1.2.2 System Acceptance Tests Plan: The Contractor shall submit to the Engineer, a comprehensive System Acceptance Tests Plan including all requirements detailed in the relevant PS. The plan shall be submitted within the period of time laid down in the PS, or, if none is given, not later than four months in advance of the date for the commencement of the System Acceptance Tests. System Acceptance test shall include the functional test of all equipment from the SM's panel/terminal.

3.7.1.2.3 Integration Testing & Commissioning Plan: The Contractor shall submit to the Engineer a comprehensive Integrated Testing and Commissioning Plan including all requirements detailed in the PS. The plan shall be submitted within the period of time laid down in PS, or, if none is given not later than four months in advance of the date for the commencement of Integrated Testing and Commissioning. This test shall include the test of equipment from the SCC/ IMD.

3.7.1.2.4 Operation and Maintenance Manuals Plan: The Contractor shall develop an Operation and Maintenance Manuals Plan to suit staged commissioning of the system and to ensure timely preparation of the Operation and Maintenance Manuals and the "As-Built" Drawings in a format and to a level of detail reviewed without objection by the Engineer. The Contractor shall submit the Operation and Maintenance Manuals Plan not later than 45 days prior to the issue of the Taking Over certificate for the works and according to the staged commissioning, if applicable, of the proposed systems.

3.7.1.2.5 Training Plan: The Contractor shall ensure the timely preparation of the Contractor's Training Plan in a format and to a level of detail reviewed without objection by the Engineer and fulfilling the requirements. The Contractor shall submit the Training Plan

by the date stated in the PS, or, if none is given, not less than three (3) months prior to the start of installation activities of the works.

3.7.1.2.6 Spares Management Plan: The Contractor shall 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. The Contractor shall submit the Spares Management Plan by not less than 60 days prior to the issue of the Taking Over Certificate for the Works.

3.7.1.2.7 Defects Liability Management Plan: The Contractor shall submit for review by the Engineer a Defects Liability Management Plan to repair, replace and perform any remedial item upon the Works identified by the Engineer during Defects Notification Period (DNP). The first submission of this plan is required not less than 365 days prior to the issue of the Taking Over Certificate for the Works. The Defects Liability period shall be 365 days after the issue of the Taking Over Certificate. The Contractor shall;

- endeavor to complete all necessary work in a timely responsible manner;
- not proceed with any remedial work without the consent of the Engineer;
- submit a plan that details the method and timing of any proposed work;

3.7.1.2.8 Maintenance Plan: The Contractor shall submit for review by the Engineer a Maintenance Plan to maintain the Signalling & Telecommunication System for the defined period in scope. The first submission of this plan is required not less than 365 days prior to the issue of the Taking Over Certificate for the Works.

(End of Chapter-3)

CHAPTER - 4 DESIGN REQUIREMENTS

4.1 GENERAL

4.1.1 The Works shall be executed in four phases viz. the Design Phase, the Manufacturing/ Supply Phase, Construction/ Installation Phase and Testing & Commissioning Phase. The various phases of the project will overlap with each other.

4.1.2 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.

4.1.3 The Contractor shall ensure that his design is accurate and in compliance with the 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.

4.2 DESIGN MANAGEMENT

4.2.1 The Contractor shall establish an office for his dedicated design team referred to as Design Team. The Design Team shall function from this office and all meetings and discussions relating to design shall be held in this office or in the office of the Engineer and/or as instructed by the Engineer. In addition to the requirements detailed herein, the Contractor shall, whenever the Engineer so requests, provide information and participate in discussions that relate to design matters.

4.2.2 The members of the Design Team shall have the requisite experience and qualification appropriate to the type and magnitude of the design involved. Full details regarding their qualifications and experience shall be submitted to the Engineer for his consent

4.2.3 The Contractor shall sub-divide all the design into Design submissions which shall be identified in the Design and Certification Submission Program. The Design submissions should relate to the significant and clearly identifiable parts of the Design and shall address the design requirements as described herein. The Design submissions 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.

4.2.4 Separate Design Submissions shall be prepared for the major equipment to be procured through sub-contract. Where such work is to be procured by the Contractor on the basis of outline design, design briefs and performance specifications, the contractor shall submit such documents as part of the Detailed Design Submissions.

4.3 GENERAL DESIGN CRITERIA

4.3.1 Design for individual equipment, system and works shall be as per Employer's Requirements described in PS(Signalling) and PS(Telecommunication).

4.3.2 The Design shall be Reliable, Energy and Cost efficient with due considerations to the Local Climate Conditions, Safety, Ease of installation, Operation, Maintenance and Future replacements.

4.3.3 **Durability and Maintenance**

4.3.3.1 The Permanent Works shall be designed and constructed such that they shall endure in a serviceable condition throughout their minimum design lives as described in the particular specifications to minimize the cost of operation and maintenance whilst not compromising safety or the performance characteristics of the HORC.

4.3.3.2 Equipment, where supplied, shall be of a quality and durability to fully meet the performance and operational requirements described in the Particular Specifications.

4.3.4 **Operational Requirements**

4.3.4.1 The Permanent Works shall be designed to permit the HORC to operate satisfactorily at a maximum permissible speed for trains in accordance with Particular Specifications.

4.3.4.2 The system offered shall be safe and reliable as safety remains a primary concern for the HORC. The methodology adopted for the design and installation of the facility shall be such as to ensure a smooth and accident-free operation.

4.3.4.3 As the HORC systems are expected to live through potentially long life the system offered and installed shall be such as to be compatible with future expansion and technological upgrades without hassles.

4.3.4.4 Since the time period for the completion of the project is limited, the system may be designed with a modular approach so that prefabricated and pretested modules are easily installed at site.

4.3.4.5 It is a requirement that the Indian Railway (IR) remains operational during the construction/ Installation phase covered in this Package.

4.3.4.6 All equipment for Signalling & Telecommunication system for HORC project shall be compatible with existing Indian Railway control equipment.

4.3.5 Aesthetics: The Permanent Works shall be designed to achieve an aesthetic character and provide a feeling of design commonality throughout the project.

4.3.6 Human Factors: The Contractor is required to comply the guidelines contained within ISO/TR 16982:2002 and the ergonomic design of systems supplied subject to acceptance by the Engineer.

4.3.7 Safety, Health and Environment Considerations: The design of the Permanent Works shall be according to Indian laws and regulations related to Safety, Health & Environment Requirements. Safety, Health & Environment aspects shall be kept in mind during the Design, Manufacturing/ Supply, Construction/ Installation and Testing & Commissioning Phases as described at appropriate places in the Bidding Document.

4.3.8 Quality Control: Quality control aspects shall be kept in mind during the Design, Manufacturing/ Supply, Construction/ Installation and Testing & Commissioning Phases as 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.

4.4 DESIGN STAGES

4.4.1 The design of this project is divided into various stages as under:

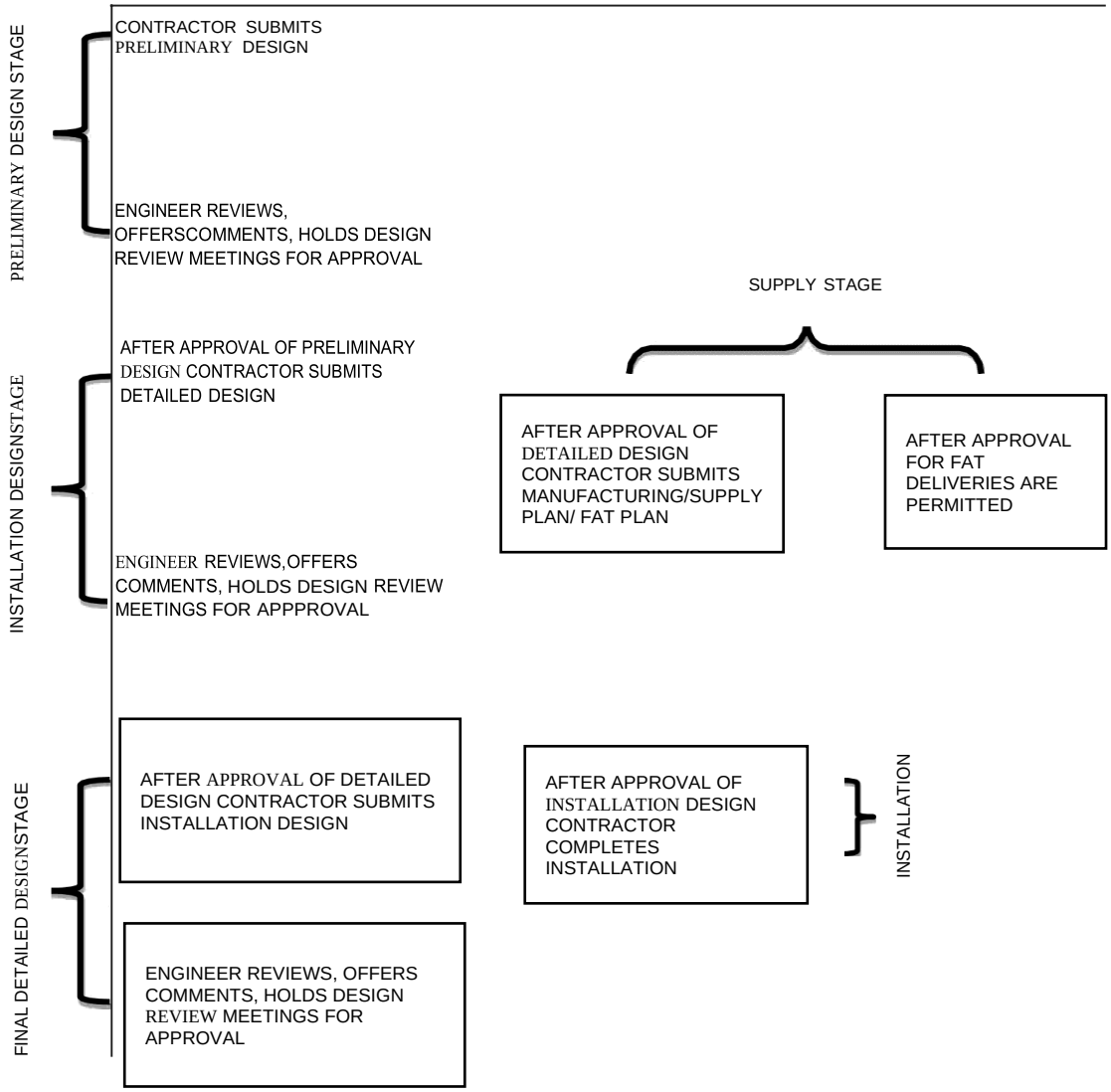
(1) Preliminary Design

(2) Detailed Design

(3) Construction/ Installation Design

(4) As Built Documents

4.4.2 The Procedure for Design Submission is laid down as under



4.4.3 **Preliminary Design & Documents**

4.4.3.1 Based on the Employer's Requirement, the Contractor shall prepare a System Requirement Specifications (SRS) which includes, as a minimum operational, functional, performance and design requirements of the proposed system.

4.4.3.2 The System Requirement Specifications, 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.

4.4.3.3 The System Requirement Specifications (SRS) shall include a compliance matrix that includes cross-references to the requirements stated in the Particular Specifications, the System Requirement Specifications and the Design Verification Table (DVT).

4.4.3.4 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. Equipment and interconnection specifications, with supporting calculations, shall be developed at this stage. Submissions shall clarify and confirm as necessary technical aspects of all interfaces with other elements of contractor's overall design and of any interfaces with systems of other contractors.

4.4.3.5 Ergonomic design, mock-ups/prototypes shall be developed during this stage.

4.4.3.6 The Contractor, during this phase, shall submit the Preliminary Design. Subsequent to the study conducted, the contractor shall develop his basic designs of the system and the sub- systems. The Safety of the entire HORC Railway Network including the work to be done by other Contractor(s) for earthing and bonding shall be an important document to be prepared for approval by the Engineer. The Basic and detailed Design Report submission shall also provide details.

4.4.3.7 The Contractor shall review the indicative General Arrangement and other Drawings, wherever applicable and suggest modification(s) and improvements based on site conditions and as a result of the simulation exercise conducted by him and approved by the Engineer.

4.4.4 Calculations

4.4.4.1 Unless otherwise required by the Engineer, calculations shall be submitted together with the Preliminary Design Package submission

4.4.4.2 A comprehensive set of calculations for the whole of the Preliminary Design, commencing from the input and output data to the Simulation Program (in the form acceptable to the Engineer) shall be submitted by the Contractor to the Engineer for consent as part of the relevant submittals

4.4.4.3 Should the design of the Works be revised thereafter, and such revision(s) render the submitted calculations superseded then the Contractor shall prepare and submit revised calculations and the revised design simultaneously

4.4.4.4 The Engineer/ Employer shall require the contractor to submit and install one copy each of all the applicable software as used by the contractor for the Design, including the Simulation Computer Program duly licensed in the name of the Employer and also 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.

4.4.4.5 The Contractor shall submit all calculations necessary to support proposals relating to the Construction/ Installation methods.

4.4.5 Detailed Design & Documents

4.4.5.1 During the preparation of the Detailed Design, the Contractor shall in particular ensure that:

- All standards and regulations have been identified and applied;
- Calculation and analysis are complete;
- All main and other significant elements are delineated;
- All protocols of Tests and Trials, All selections of material and equipment are complete;
- Full account of the effect on the Project Works of the proposed methods of Installation, Testing & Commissioning and of the Temporary Works have been taken into account; and
- Completion of 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.

4.4.5.2 The Detailed Design shall be based on the Preliminary Designs developed to the stage at which all subsystems of the Works are fully designed and specified

4.4.5.3 The Designs shall be submitted within the specified period as per the Design Submission Program consented by the Engineer

4.4.5.4 The Detailed Design shall include the Technical Drawings, the Works Specifications, the Detailed Design Report and All other contents of the Detailed Design Submittals

4.4.5.5 The Temporary Work, if any, shall also be identified as a separate Work 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

4.4.5.6 The Contractor shall demonstrate, to the satisfaction of the Engineer, the adequacy of the ratings of the equipment and conductors and their suitability entailing all load, permanent and temporary, and also its effects on other Contracts

4.4.5.7 Upon completion of Internal Authorization Process, the Contractor shall submit the Detailed Design as described herein, Requirements for Design, to the Engineer for

consent and issue of a "Notice of No Objection".

4.4.5 Construction/ Installation Design: Upon the issue of a Notice of "No Objection" in respect of a Detailed Design Submission, the Contractor shall produce the respective Construction/ Installation Design Submission which shall include, but not limited to,

4.4.5.1 The Technical Drawings

4.4.5.1.1 The updated Works Specifications including Method Statements/ Work procedures/ Construction/ Installation sequences

4.4.5.1.2 The Construction Sequence Statement: The document illustrates the sequence of one cycle of particular construction implementation in which such sequence is critical to maintain the quality, safety and/ or any other important factors of the construction implementation

4.4.5.1.3 The Safety Risk Assessment: The analysis describes and evaluates the risks associated with the construction implementation anticipated in the course of the construction

4.4.5.2 The Working Drawings

4.4.5.2.1 The Site Drawings: these are supplementary detail drawings which expand and explain the information shown on the Construction Technical Drawings based on the site conditions and dimensions existing there

4.4.5.2.2 The Fabrication Drawings: These are supplementary drawings of specific elements of the works such as for the switchyards, portal structures shown on the Construction Technical Drawings for the purpose of manufacture or fabrication of those element and erection

4.4.5.2.3 All other drawings as deemed necessary by the contractor for the accurate and safe construction of the Works in accordance with the Contract

4.4.5.3 Technical Drawings, updated Works Specifications/ Method Statements etc. shall be derived directly from the Detailed Design as approved by the Engineer including changes that may be necessary to resolve the comments of the Engineer attached to the Notice of No Objection.

4.4.5.4 The Working Drawings and the Construction/Installation Practicing Documents shall be prepared to facilitate Construction/ Installation to meet the required workmanship as well as technical requirements. The Works Management Plans shall be prepared to check and monitor the Works in terms of SHE requirements described in this bidding document.

4.4.5.5 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/ Installation" as per the Internal Authorization Process as defined in the Design Quality Assurance Plan detailed in this bidding document. If the Engineer so requires, the said endorsed original paper drawings shall be re-submitted to the Engineer, who shall, if he 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 be returned to the Contractor forthwith as Working Drawings to be

issued to the Site.

4.4.5.6 Technical Drawings and the Working Drawings shall be used for Construction/ Installation 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.

4.4.5.7 The Construction/ Installation of the Works shall be strictly in accordance with the Construction/ Installation Design Submission for which "Notice of No Objection" has been issued by the Engineer and "Good For Construction/ Installation" drawings have been issued as per the authorization process detailed as above.

4.4.5.8 **The Construction/ Installation Design** may be divided into multiple submissions for different Work Segments, in such a case,

4.4.5.8.1 Construction/ Installation Design and Drawings in respect of each subsystem in a Work Segment shall be submitted for the entire subsystem

4.4.5.8.2 Submittals which are commonly applicable to the subsequent submissions shall be submitted in the initial submission and each submission shall include, correlated and interdependent the submittals.

4.4.5.8.3 The Contractor shall submit the Construction/ Installation Design and Drawings for a particular work to the Engineer at least 2 months but not more than 4 months prior to the planned / scheduled date of commencement of that particular work.

4.4.5.8.4 The Construction/ Installation Design submission shall be a coherent and complete set of documents in line with the Detailed Design which has received "Notice of No Objection" from the Engineer and shall fully describe the proposed Construction/ Installation Design.

4.4.5.9 **The Good for construction** drawings for Signalling & Telecommunication works shall include but not limited to:

4.4.5.9.1 All drawings and documents described for Preliminary/ Detailed Design & Documents for Signalling Works.

4.4.5.9.2 All drawings and documents described for Preliminary/ Detailed Design & Documents for Telecommunication Works.

4.4.6 As-Built Drawings & Documents

4.4.6.1 The Contractor shall maintain all records necessary for the preparation of As-Built Drawings & Documents. 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 in accordance with the Conditions of Contract, the Contractor shall prepare the As-Built Drawings and Records which, subject to the Engineer's agreement, shall become the contents of the As-Built Documents.

4.4.6.2 The As-Built Drawings shall be a full set of the latest revisions of the Preliminary/ Final Detailed/Construction/Installation Designs and Drawings (updated to incorporate all Design Change Notices and Field Change Notices) and as many Working Drawings as necessary to convey a full and true record of the as-built condition of the Works. The As-

Built Drawings shall show all changes from the Preliminary/ Final Detailed/ Installation Design and all other features relevant to the future maintenance and management of the HRIDC and its facilities. The As-Built Drawings shall be endorsed by the Contractor as true records of the construction/Installation of the Works.

4.4.6.3 Configuration data tables shall be prepared for each individual sub-system on item by item basis as well as on location basis.

4.4.6.4 The As-Built Documents shall also incorporate the changes to dimension and details from the Construction Drawings and changes due to variation orders.

4.4.6.5 Following shall also be part of the all As-Built Documents :

4.4.6.5.1 Official letters regarding the design change acceptance;

4.4.6.5.2 Certificates of acceptance between the Contractor and the Engineer;

4.4.6.5.3 Design Certificate.

4.4.6.5.4 Station Working Rule and Station working rule Diagrams.

4.4.6.5.5 Document and drawings for NI

4.4.6.5.6 Operational Safety case

4.4.6.5.7 CRS sanction supporting documents

4.4.6.5.8 Operation & Maintenance manuals for whole Signalling and Telecommunication system/ subsystems

4.4.6.6 As part of the As Built Documents, the Contractor shall maintain all records necessary for the financial completion and commissioning of the project. These records shall consist of as a minimum, but not limited to the following:

4.4.6.6.1 The implemented work according to Activities, Places and Price

4.4.6.6.2 Used Material — Type, Name of manufacturers along with batch number, place and price etc.

4.4.6.6.3 Any other record as required by the Engineer.

4.4.6.7 The As-Built Drawings & Documents shall be submitted to the Engineer for consent and issue of a "Notice of No Objection" at no extra cost to the Employer.

4.5 SYSTEM ASSURANCE SUBMISSIONS:

System Assurance Plan includes but not limited to:

4.5.1 System RAM Plan

4.5.2 System Safety Plan

4.5.3 Safety policy

4.5.4 Hazard Analysis and Hazard Log

4.5.5 Design/System Safety Studies and Report

4.5.6 RAM Analysis and Prediction Report

4.5.7 FMECA

4.5.8 RAM Demonstration plan

4.5.9 Engineering Safety Validation Report

4.5.10 Operational Safety case

4.6 CONTRACTOR'S COORDINATION WITH OTHERS

4.6.1 The Contractor shall fully coordinate the design of the Works with the design of other contractors and shall follow the interfacing requirements as stipulated in the paragraph 3.3.2 of this document for Interface Requirement.

4.6.2 Those Works, which are required to be executed by the other contractors, shall be fully coordinated and integrated throughout the Detailed Design development and the results shall be recorded and summarized in the Combined Service Drawings (CSD) and the Interface Report on other contractors as part of the Detailed Design and the Construction/Installation Design.

4.6.3 Coordination with External Related Parties: 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, Adjacent Indian Railway Authorities and the 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 as detailed in CHAPTER-3 of this document for Interface Requirement.

4.6.4 Co-ordination with Indian Railways:

4.6.4.1 For some S&T Works proposed by Contractor and having implication over working of Indian Railways and its Systems, approval from Indian Railways through the Employer shall be required, in addition to the consent by the Engineer. The Contractor shall be required to submit three additional copies of such Preliminary Design & Detailed Design to the Engineer for onward submission to Indian Railways.

4.6.4.2 The Contractor shall co-ordinate in seeking the approval from Indian Railways, however, the Employer shall facilitate the Contractor in seeking the approval from Indian Railways including, but not limited to, providing clarifications / additional data, attending meetings etc. as required.

4.6.4.3 It will be the Contractor's responsibility to take approval of Indian Railways on the designs/ works, however the Employer will extend all assistance in seeking these approvals.

4.7 CONTRACTOR'S WARRANTY OF DESIGN

4.7.1 The Contractor shall give warranty to the Employer that the design produced by them (in accordance with the Conditions of Contract) meets the Employer's Requirements and Specifications provided by the Employer and is fit for the purpose thereof. In accordance with Design Certificates as Appendix-8 of this bidding document. Where, there is any inadequacy, insufficiency, impracticality or unsuitability from the Employer's Requirements

and Specifications 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.

4.7.2 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 set out in this clause.

4.7.3 The Contractor shall further specify and shall deemed to have checked and accepted full responsibility for the Contractor's part of the design (in accordance with Conditions of Contract) notwithstanding.

4.7.4 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 and/ or his qualified personnel/ persons or cause to be prepared, developed or issued by others.

4.7.5 Any warranties, guaranties and/ or indemnities that may be or may have been submitted by any other person.

4.7.6 That the same have been accepted by the Engineer.

4.7.7 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.

4.7.8 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 Contractor shall arrange necessary clearances and approvals before the work is taken up. Nothing extra will be paid by Employer on this account.
- Ignorance of rules, regulations and bye-laws shall not constitute a basis for any claim at any stage of work.

4.7.9 The Design Warranty shall be submitted by the Contractor to the Employer as per the Design Certificate. Design life has been described in Particular specification of Signalling & Telecommunication system.

4.7.10 The Contractor shall ensure supply of the spares during the Design life of the Signalling/ Telecommunication System.

4.8 DESIGN CHANGES

4.8.1 If there is a requirement to change the 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, the Design change through either a Field Change Notice (FCN) or a Design Change Notice (DCN).

4.8.2 These design changes shall go through the full process of the Design Review Procedure as described in the Chapter-6 of this document for Quality Assurance.

(End of Chapter-4)

CHAPTER 5 - SUPPLY, INSTALLATION, TESTING AND COMMISSIONING

5.1 GENERAL

5.1.1 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.

5.1.2 The Contractor shall establish Comprehensive Test and Inspection instructions for Procurement/ Manufacturing, Packaging, Marking, Shipping, Handling, Storage and Preservation, to protect the quality of the Material/ Equipment/ Components and to prevent Damage, Loss, Deterioration, Degradation or Substitution thereof.

5.2 PROCUREMENT/ MANUFACTURING

5.2.1 The Contractor shall ensure that all the material required for the work is Manufactured/ Procured, Inspected, Tested and Delivered as per the Specifications and Guidelines specified in the Employer's requirements.

5.2.2 In order to ensure Quality in Procurement/ Manufacturing, the Contractor shall

5.2.2.1 Make a Procurement Management Plan, comprising of the details on Procurement, Manufacturing and Delivery in respect of all items and goods;

5.2.2.2 Detailed Method statements for various activities such as Purchasing, Manufacturing, Inspection etc.

5.2.2.3 Prepare a Material Delivery Plan;

5.2.2.4 Develop and maintain a Material Control Schedule;

5.2.3 Manufacturing Inspection and Test provisions:

5.2.3.1 All the material procured/ manufactured shall be inspected and tested

5.2.3.2 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

5.2.3.3 At each hold point, the Engineer shall hold a formal inspection or advise that the inspection has been waived

5.2.3.4 In order to facilitate such an inspection, the detailed Production/ Manufacturing plan shall be provided by the Contractor to the participants of the inspection, at least three 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

5.2.3.5 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.

5.2.3.6 The material delivered at the Site and offered for Inspection shall be manufactured normally not earlier than one (1) year and their Warranty period shall at least cover the Defects Notification Period.

5.2.3.7 The Signalling and Telecommunication Equipment/ Material shall be inspected by RDSO/ RITES as the case may be. And the inspection charges for the same shall be borne by the Contractor. Material which are inspected by Consignee if required to be

tested in the authorized Test labs as per the instruction of the Engineer, then such testing charges shall also be borne by Contractor.

5.3 PACKAGING, SHIPPING AND DELIVERY

5.3.1 Packaging and Shipping

5.3.1.1 The Packaging and Shipping of the equipment shall be designed and implemented to minimise damage whilst in transit.

5.3.1.2 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.

5.3.1.3 The contents of each case, crate or package shall be protected against the harmful effects of ingress of moisture / water/ electrostatic charge by enclosing within a heavy duty waterproof membrane/ electro static shield.

5.3.1.4 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.

5.3.1.5 Each case, crate or package shall contain a comprehensive packing list showing the number, mark, size, weight and contents together with any relevant drawings. 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.

5.3.1.6 All items shall be marked on the outside of the case to show the gross and net weights, the points for slinging and where the weight is bearing.

5.3.1.7 Care shall be taken to prevent movement of equipment within containers by the provision of bracing, straps and securing bolts as necessary.

5.3.1.8 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.

5.3.1.9 Details of cases, crates, packages, containers, etc., intended to hold important or delicate items of equipment or material shall be submitted to the Engineer for acceptance.

5.3.1.10 Sub-Assemblies: All components shall be packed together and properly labeled and numbered. Diagrams to ensure that they are properly assembled at site in the required order of components shall also accompany the packaging.

5.3.1.11 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/ Electronic and other delicate items or equipment shall be cocooned.

5.3.1.12 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.

5.3.1.13 Tube ends and other similar openings shall be thoroughly cleaned and then blanked- off to prevent ingress of dirt or moisture.

5.3.1.14 Flanged ends shall be protected by adhesive tape or jointing material covered by a properly secured wooden blank not smaller than the flange itself.

5.3.1.15 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.

5.3.1.16 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.

5.3.1.17 Care shall be taken to minimize risk of damage to ball and roller bearings and any fragile material in transit.

5.3.1.18 The Contractor shall ensure satisfactory completion of manufacturing and testing check prior to shipment.

5.3.1.19 All shipments shall be adequately protected to preclude damage during shipment. The Contractor's quality control personnel shall verify the inspection and preparation for shipment.

5.3.1.20 The Handling procedures shall include the use of special crates, boxes, containers, transportation vehicles, equipment and facilities for material handling.

5.3.2 **Cable Drums**

5.3.2.1 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.

5.3.2.2 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.

5.3.2.3 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.

5.3.2.4 Cables shall be supplied on drums in the longest possible lengths and within practical limits.

5.3.2.5 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.

5.3.2.6 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.

5.3.2.7 Each drum shall bear a distinguishing number and label "HORC", either printed or neatly chiseled on the outside of a flange.

5.3.2.8 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. In addition the words "Running End 'A"' or "Running End 'Z"' as appropriate shall be marked on the flange and the direction for rolling shall be indicated by an arrow.

5.3.2.9 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 HORC area.

5.3.3 **Storage and Delivery**

5.3.3.1 Unless otherwise consented by the Engineer, the Contractor shall provide adequate storage facilities by way of covered areas at his own cost 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.

5.3.3.2 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 and no extra cost/ compensation to the Contractor.

5.3.3.3 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.

5.4 WARRANCY CERTIFICATES FROM OEM:

5.4.1 All Original Warranty Certificates of OEMs of all Signalling & Telecommunication sub system or equipment including Contract spare, Commissioning spare, DLP spares and Special tools & Test and Measuring Equipment shall be valid for Three years or as specified in RDSO Specification of the equipment whichever is later and registered in the name of the Employer. These warranty certificates received from the OEMs shall be passed on to the Employer before Taking over

5.4.2 Validity of period of Warranty Certificates shall start from date of Commissioning

5.4.3 Original invoice shall also be submitted with the OEM warranty certificates in a booklet form before Commissioning

5.4.4 Warranty period support shall start from the date of Commissioning

5.5 CONSTRUCTION/ INSTALLATION

5.5.1 The Installation shall be carried out by competent and skilled staff. The Contractor shall ensure that his staffs are competent and possess all the necessary skills to carry out the installation in a proper and safe manner.

5.5.2 The Installation shall be carried out with necessary and sufficient resources such as Tools, Test instruments, Spares, Equipment, Manpower and Communication facilities.

5.5.3 During installation, every precaution shall be taken to protect the 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.

5.5.4 All the Installation works shall be supervised to ensure that and technical, safety and quality matters adhere to the Design as reviewed by the Engineer.

5.5.5 The Installation shall be done in accordance with the approved Installation Plan and Method Statements. All installation activities shall commence only after the method statement and related submissions have been reviewed without objection by the Engineer.

5.5.6 The Installation Method Statements 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.

5.5.7 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.

5.5.8 During installation, care may be taken to ensure that the manufacturer's erection instructions are correctly followed.

5.5.9 The installation for major items such as important components and vital equipment of Signalling & Telecommunication System shall be undertaken preferably in the presence of the manufacturer's field service representative.

5.5.10 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.

5.5.11 Upon noticing or being advised of any inconsistency between the installation drawings and documentation and the installed equipment, the Contractor shall notify his acknowledgement to the Engineer and shall correct such errors within two weeks.

5.5.12 Equipment that is improperly installed shall be removed, shall be checked/ tested and shall be reinstalled. Any damage caused due to improper installation and removal shall be rectified before reinstallation at no extra cost to the Employer.

5.6 ASSET IDENTIFICATION

5.6.1 The Contractor shall submit an asset database for review by the Engineer. The database shall contain the complete asset listing for all aspects of the contract works.

5.6.2 The database shall provide the following information, but not limited to:

5.6.2.1 Asset Details:

5.6.2.1.1 Date Manufactured

5.6.2.1.2 Date Installed

5.6.2.1.3 Date(s) Tested

5.6.2.1.4 Failure History

5.6.3 All equipment and software shall have a Unique Identification Number that can be identified electronically and manually.

5.7 TESTING AND COMMISSIONING

5.7.1 General

5.7.1.1 The Contractor shall provide and perform all forms of Testing procedures applicable to the Works relating to Plant & Equipment, 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 and Site Acceptance Tests.

5.7.1.2 The Commissioning Activity shall include a period of the Integrated System Testing followed by a period of Trial Run.

5.7.1.3 Within 6 months from the date of Commencement of the Work, the Contractor shall submit a comprehensive Testing Program defining the Personnel, Procedure and Format of Testing.

5.7.1.4 All Testing procedures shall be submitted at least twenty-eight (28) 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.

5.7.1.5 The Testing procedures shall be submitted by the Contractor and shall be 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.

5.7.1.6 The contractor shall facilitate the Engineer's Personnel to monitor all Tests and to have access to all testing records.

5.7.1.7 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.

5.7.1.8 The Contractor shall keep in mind that at some point of time, the Electric Traction System shall be energised 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 with Installation, Testing and Commissioning Programs of all the Contractors and all Associated with the Traction Power Energisation Program.

5.7.1.9 All costs associated with the testing shall be borne by the Contractor. This shall include the Inspection/ Testing Charges to be paid to RDSO/ RITES/ Test Laboratories. The Contractor shall also bear any expense incurred due to resetting/ retesting caused by defects or failure of equipment to meet the requirements of the Contract in the first instance.

5.7.1.10 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.

5.7.1.11 Unless agreed to in writing by the Engineer, the personnel engaged on testing shall be independent of those directly engaged in the design or installation of the same equipment.

5.7.1.12 All Testing equipment shall carry an appropriate and valid calibration label. They shall be periodically checked for calibration accuracy.

5.7.1.13 All reports of the tests shall be signed by the Contractor's Representative.

5.7.2 **Testing Philosophy**

5.7.2.1 Testing of various items shall be carried out as per the Testing procedures approved by the Engineer. An appropriate format for Test Schedule(s) and Procedure(s) including the details of testing equipment shall be submitted to the Engineer for approval.

5.7.2.2 Unless otherwise agreed, all Tests shall be witnessed and signed by the authorized representative of the Engineer & recorded. Attendance on Tests, including that by Engineer and the Contractor shall be as laid down in the Quality Assurance procedures detailed in this bidding document.

5.7.2.3 All Tools & instruments for carrying out the tests shall be arranged by the Contractor to the satisfaction of the Engineer.

5.7.2.4 Prior to shipment of equipment, the Engineer's Personnel reserve the right to witness the testing of the equipment at the manufacturers' works.

5.7.3 **Sequence of Tests:** The sequence of tests shall generally comprise of the following:

5.7.3.1 Type Tests, as and when required;

5.7.3.2 Factory Acceptance Tests (FAT);

5.7.3.3 Installation Tests;

5.7.3.4 System / Sub-system Acceptance Tests (SAT);

5.7.3.5 Integrated Testing & Commissioning; and

5.7.3.6 Trial Run.

The details on each type of Tests have been covered in the respective PS(Signalling works) and PS(Telecommunications works).

5.7.4 **Samples for Testing**- Samples that have been tested may be utilized in the Works provided that:

5.7.4.1 The sample complies with the specified requirements;

5.7.4.2 The sample is not damaged;

5.7.4.3 The sample is not required to be retained under any other provision of the Contract; and

5.7.4.4 Consent of the Engineer has been obtained, in writing.

5.7.4.5 Additional samples shall be provided for Testing, if in the opinion of the Engineer:

5.7.4.5.1 Material previously tested no longer complies with the specified requirements; or

5.7.4.5.2 Material has been handled or stored in such a manner that it may not comply with the specified requirements.

5.7.5 **Test Certificates and Reports**

5.7.5.1 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, 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.

5.7.5.2 The Contractor shall submit to the Engineer for review, not less than six (6) months before Testing and Commissioning activities commence, his proposed format for the testing and commissioning records. The records shall be appropriately sub-divided to make provision for the various parts of the Permanent Works covered by the Contract.

5.7.5.3 The format of the records shall cover all tests, including tests to be conducted after modification of the design/ installation based on DCN/ FCN.

5.7.5.4 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 can be issued or Statutory requirements can 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.

5.7.5.5 The Contractor shall prepare two (2) copies of an Inspection or Test report immediately after the completion of each inspection or test whether or not witnessed by the Engineer. If the Engineer 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 Engineer has not witnessed the inspection or test (i.e. if a waiver has been granted), 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 Engineer may call for a re-inspection or re-test.

5.7.5.6 At the end of each inspection/ test or group of tests, the Contractor shall obtain report

which shows the result of all the inspections and/ or tests carried out. If required by the Engineer, a manuscript copy of the test record shall be made at the time of the test and shall be given to the Engineer at the earliest opportunity if the test has not been witnessed.

5.7.5.7 The contractor shall carry out an analysis of the results and 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. Summaries of Inspection and/ or Test shall be submitted to the Engineer.

5.7.5.8 The 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.

5.7.5.9 In addition to any other requirements, the report shall contain but not limited to, the following details:

5.7.5.9.1 Material or part of the Works tested;

5.7.5.9.2 Location of the batch from which the samples were taken or location of the part of the Works;

5.7.5.9.3 Place of testing;

5.7.5.9.4 Date and time of tests;

5.7.5.9.5 Weather conditions in the case of in-situ tests;

5.7.5.9.6 Technical personnel supervising or carrying out the tests or inspection;

5.7.5.9.7 Size and description of samples and specimens;

5.7.5.9.8 Method of sampling;

5.7.5.9.9 Number and types of tests which are required to be done.

5.7.5.9.10 Specified acceptance criteria;

5.7.5.9.11 Tests actually carried out.

5.7.5.9.12 Method of testing or inspection;

5.7.5.9.13 Properties tested or inspected;

5.7.5.9.14 Test results, including any calculations and graphs;

5.7.5.9.15 Results actually achieved

5.7.5.9.16 Confirmation of pass/ failure accompanied with, if necessary, a schedule of further tests or actions to be carried out by the Contractor to achieve compliance with the Specification and the approved design.

5.7.5.9.17 All relevant checklists and work sheets used during the inspection and/or test , including readings and measurements taken during the tests; and

5.7.5.9.18 Other details stated in the Contract.

5.7.5.9.19 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-5)

CHAPTER 6 - QUALITY ASSURANCE

6.1 GENERAL

6.1.1 The Contractor shall maintain and implement a Quality Management System that shall remain in effect during the execution of the Works. The Contractor's Quality 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.

6.1.2 The Project Quality Assurance Plan documentation shall include, but not be limited to the following:

6.1.2.1 Project Quality Assurance Plan (Contractor's Integrated Quality assurance documentation);

6.1.2.2 Design Quality Assurance Plan;

6.1.2.3 Site Quality Assurance Plan (including Inspection and Test Plan);

6.1.2.4 Manufacturing Quality Assurance Plans (including Inspection and Test Plan); and

6.1.2.5 On-site Inspection Plan for Resources Procurement;

6.1.3 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.

6.1.4 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.

6.2 SUBMISSION OF QUALITY DOCUMENTATION

6.2.1 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.

6.2.2 Within 42 days after the Commencement Date, the Contractor shall submit the following documents for review by the Engineer:

6.2.2.1 Contractor's Quality Assurance Philosophy;

6.2.2.2 Project Quality Assurance Plan; and

6.2.2.3 Design Quality Assurance Plan and any associated work instruction and/ or standard form which the Contractor proposes to be used for the Contract.

6.2.3 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 the relevant chapters about Manufacturing, Supply, Construction/ Installation, Testing & Commissioning and Requirements on Documents and Drawings.

6.2.4 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 forces 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 as part of Detailed Design development as summarized in Requirements on Documents and Drawings.

6.2.5 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.

6.2.6 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.

6.2.7 Records of certifications shall be maintained and monitored by the Quality Assurance personnel. These records shall be made available to the Engineer for inspection and review as and when required.

6.2.8 The Quality Assurance operations shall be subject to the Engineer's verification at any time.

6.2.9 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.

6.2.10 The Contractor's Quality Audit schedule shall be submitted to the Engineer for consent every three months or more frequently as required.

6.2.11 The Contractor shall provide all necessary access, assistance and facilities to enable the Engineer 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.

6.3 CONTROLLED COPY OF QUALITY SYSTEM DOCUMNETATION

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.

6.4 PROJECT QUALITY ASSURANCE PLAN

6.4.1 **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:

6.4.1.1 A dedicated Quality Assurance Team

6.4.1.2 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;

6.4.1.3 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.

6.4.1.4 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

6.4.1.5 Hierarchy of the quality management system documentation for managing and controlling the whole system.

6.4.2 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.

6.4.3 The Project Quality Assurance Plan shall without limitation include Quality Assurance procedures for Design, Manufacturing, Supply, Installation/ Construction, 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.

6.4.4 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 framework 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:

6.4.4.1 The Quality Assurance Plan is fully observed at all times and

6.4.4.2 Any non-compliant and sub-standard material, practice and/ or work are brought back to compliance.

6.4.5 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:

6.4.5.1 Review, approval and updating management of the quality system documents to ensure their continuing suitability and effectiveness;

6.4.5.2 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 design submittals and the design packages described under the Contract;

6.4.5.3 Drawing management in the Contractor's Main office and Site office(s), including procedures of production, approval, updating, maintaining, storage and distribution;

6.4.5.4 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;

6.4.5.5 Monitoring, recording and control of the quality system of his Sub-Contractors with respect to their quality of works with relevant time schedule; and

6.4.5.6 Quality control of the Works including Quality audits to be held on the Contractor and Sub-Contractors, Suppliers and Design consultants of any tiers.

6.5 DESIGN QUALITY ASSURANCE PLAN

6.5.1 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:

6.5.1.1 Organization of the Contractor's Design Team in context with the Contractor's entire organization so that it functions appropriately;

6.5.1.2 Allocation of responsibilities and authorities to be given to the Design Team, to the individual identified design staff and the Subcontractor for particular design works especially the Internal Authorization Process as detailed herein in Chapter-4 for Design Requirements.

6.5.1.3 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; and

6.5.1.4 A list of general procedures to be applied to manage and control the quality of the design works.

6.5.1.5 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.

6.6 DESIGN REVIEW

6.6.1 Contractor's Design Team

6.6.1.1 The Contractor shall be responsible for the Design of the Works and shall ensure his design is correct/ accurate and is in compliance with the Employer's Requirements and Specifications contained in the Contract. The Contractor shall also be responsible for the Construction, Installation, Testing and Commissioning of the Works and shall

ensure that all the completed Works are in line with his Design and concurrently in compliance with the Employer's Requirements and safe.

6.6.1.2 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.

6.6.1.3 Sr. Design Engineer

6.6.1.3.1 The Contractor shall appoint fully qualified and experienced Sr. Design Engineer. The Sr. Design Engineer shall act as a Representative of the Design Team and shall be wholly responsible for the Contractor's design Works.

6.6.1.3.2 The Sr. Design Engineer shall be responsible for establishing, implementing, maintaining and recording Design Quality Assurance Plan.

6.6.1.3.3 The Sr. Design Engineer shall be able to discharge his duties without any hindrance or constraint. Accordingly, the Sr. 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 Sr. Design Engineer shall be responsible and shall report to and shall seek the consent of the Engineer for the same. The Contractor shall also identify personnel necessary under the supervision of the Sr. 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.

6.6.1.3.4 The Contractor shall submit details of the authority and responsibility of the proposed Sr. Design Engineer for review and consent by the Engineer, as part of the Project Quality Assurance Plan.

6.7 INTERNAL AUTHORIZATION

6.7.1 All **Design submissions** including Detailed Design, Construction/ Installation Design, As-Built Drawings/ Documents shall include a valid "Design Certificate" as per format given in this document duly signed by Sr. Design Engineer in the Contractor's Design Team and Contractor's authorized Representative, thereby demonstrating that:

6.7.1.1 Design of the Permanent Works complies with the relevant Particular Specifications

6.7.1.2 In-house checks have been undertaken to conform the Completeness, Adequacy and Validity of the Design as per all the Quality Assurance procedures

6.7.1.3 All the required Approvals have been obtained

6.7.1.4 Design has been performed and finalized utilizing the skills of a Professionally Qualified, Competent and Experienced Designers and Engineer(s)

6.7.2 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. Format of the design certificate is available in Appendix-8 (Design Certificate).

6.7.3 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 Sr. Design Engineer before issuing it to the Site or submitting to the Engineer for his endorsement as specified in Chapter-4 - Design Requirements.

6.8 SITE QUALTIY PLAN

6.8.1 **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:

6.8.1.1 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;

6.8.1.2 Allocation of responsibilities and authorities given to identified personnel or Subcontractors for particular construction and installation of the Works;

6.8.1.3 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

6.8.1.4 A list of sequences to be applied to Manage, Control and Record the construction and installation of the Works.

6.8.2 On-site Inspection and Test provisions

6.8.2.1 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

6.8.2.2 The Contractor shall prepare and maintain a full list of all Inspection and Test Plans needed under the Contract with submission status and review status and shall submit to the Engineer for his consent.

6.8.2.3 Each **Inspection and Test Plan** for the particular activity shall define, without limitation:

6.8.2.3.1 Scope of activities covered by the plan;

6.8.2.3.2 A sequence of the Work related to the activities in the scope;

6.8.2.3.3 Personnel responsible for undertaking the inspections and/ or tests and the personnel responsible for certifying the inspections and tests;

6.8.2.3.4 Inspections and/ or test methods, their frequency, and/or reference material to the relevant standard of the inspections and/or the tests;

6.8.2.3.5 Compliance criteria of the inspections and/ or tests with clear descriptions of the quality hold point and the quality control point;

6.8.2.3.6 Documents to be used for reporting the results of the inspections and/ or tests with sample documents incorporated into the Plan; and

6.8.2.3.7 Methods of record keeping and document storage as to the locations to be maintained/ stored and procedures for those to be acknowledged/ filed.

6.9 MANUFACTURING MANAGEMET AND QUALITY ASSURANCE PLANS

6.9.1 Manufacturing Quality Management Provisions

6.9.1.1 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 (for other than RDSO approved firm) and submit them to the Engineer for consent.

6.9.1.2 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:

6.9.1.2.1 Scope of activities and items covered by the plan;

6.9.1.2.2 Organization of the Contractor and/ or the Subcontractor responsible for the day to day management of the manufacturing process of the items;

6.9.1.2.3 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;

6.9.1.2.4 Specific methods including handling and management of the manufacturing process and manufactured items, including but not limited to the following:

6.9.1.2.4.1 Particulars of the material to be used in the manufacturing process;

6.9.1.2.4.2 Monitoring and management of manufacturing process in compliance with the approved drawings and specifications;

6.9.1.2.4.3 Identification or referencing procedures for traceability of the manufactured items;

6.9.1.2.4.4 Identification of the inspection and test status of the material and the final manufactured item;

6.9.1.2.4.5 Disposition of nonconforming material and the manufactured item;

6.9.1.2.4.6 Handling, storage, packaging, preservation and delivery of the manufactured item; and

6.9.1.2.4.7 Procedure of monitoring and recording of the ordering and delivery of the item.

6.9.2 Manufacturing Inspection and Test provisions

6.9.2.1 The Manufacturing Inspection and Test Plans to be prepared by the Contractor shall cover all the requirements.

6.9.2.2 In addition to the inspection by the Contractor and the Engineer, the Employer may, at his own cost, depute its representative or nominate any other independent inspection agency 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 participantsof 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.

6.10 SOFTWARE QUALITY ASSURANCE PLAN

Each software supplier for Contractor will assure software dependability by establishing and implementing a **Software Quality Assurance Plan (SQAP**). The SQAP will:

6.10.1 Identify, monitor and control all technical and managerial activities necessary to ensure that the software achieves the required quality.

6.10.2 Ensure that an audit trail is established which enables verification and validation that the SQAP activities were effectively completed.

6.10.3 Each software supplier will provide evidence that the SQAP activities were carried out, by submitting the documents in given in the Table below.

Documentation
Software Project Management Plan
Software Quality Assurance Plan
Software Configuration Management Plan
Software Verification and Validation Plan
Software Requirements Specification
Software Design Description
Traceability

6.11 ON-SITE INSPECTION PLAN FOR RESOURCES PROCUREMENT

6.11.1 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, Installation equipment, labor 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

6.11.2 Onsite Inspection Plan for resources procurement to be prepared by the Contractor shall cover all the requirements as described in GS and PS.

6.12 TESTS

6.12.1 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.

6.12.2 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.

6.12.3 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 show the following unambiguously but not limited to:-

6.12.3.1 List of resources that shall carry out the various testing activities and their capabilities.

6.12.3.2 Date on which the Contractor proposes to conduct each of these listed tests;

6.12.3.3 nature and purpose of test;

6.12.3.4 extent of testing covered by each submission;

6.12.3.5 method of testing and tests requirements with the relevant standards;

6.12.3.6 relevant drawing and document (or modification) status;

6.12.3.7 location of testing;

6.12.3.8 test parameters to be measured with the relevant standards;

6.12.3.9 constraints to be applied during the test with the relevant standards;

6.12.3.10 defined pass/ fail criteria with relevant standards;

6.12.3.11 format of the raw data for processing by the Contractor; and

6.12.3.12 test instrumentation and test circuitry to be used during the test with the relevant standards.

6.13 QUALITY AUDITS

6.13.1 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.

6.13.2 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.

6.13.3 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.

6.13.4 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.

6.14 NOTIFICATIONOF NON-CONFORMITIES

6.14.1 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.

6.14.2 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 else Engineer may take suitable punitive action/measures.

6.14.3 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.

6.15 MONTHLY PROGRESS REPORT ON QUALITY MANAGEMENT SYSTEM

6.15.1 The Contractor shall continuously monitor the performance of the Quality Management system and shall include the same in each Monthly Progress Report as required in Monthly Progress Report.

6.15.2 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:

6.15.2.1 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;

6.15.2.2 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;

6.15.2.3 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; and

6.15.2.4 Summaries any actions proposed by the Contractor to overcome any nonconformity.

6.15.3 The Engineer shall submit the same to the Employer along with his observations/ Comments before 15th working day of each month.

6.16 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-6)

CHAPTER 7 - RELIABILITY, AVAILABILITY, MAINTAINABILITY & SAFETY

7.1 GENERAL

7.1.1 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:

7.1.1.1 The objectives and requirements of the project have been satisfied.

7.1.1.2 All systems and components of the works are defined appropriately with verifiable performance benchmarks.

7.1.1.3 Proper designs, Calculations and Simulation tools have been used.

7.1.1.4 The work has been executed by suitably competent people.

7.1.1.5 The designs have been verified by the competent authorities.

7.1.1.6 Any manufacturing, construction, installation, testing and commissioning works associated with the project have been validated.

7.1.1.7 Safety related aspects of the systems have been identified, analysed and risks mitigated such that residual risks have been demonstrated to be as low as reasonably practicable for all project stages.

7.1.1.8 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.

7.1.2 The activities shall apply to software design as well as hardware and hardware application designs.

7.1.3 The Contractor shall co-ordinate results of analysis with each engineering discipline, particularly as the results affect engineering and hardware development.

7.1.4 The Contractor shall make recommendations for re-engineering or modifications necessary to assure compliance with specified requirements including redundancy, utilisation of high reliability components, built-in self-diagnostics and "self-healing"; utilisation 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.

7.1.5 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.

7.2 RELIABILITY-AVAILABILITY-MAINTAINABILITY-SAFETY PLAN

7.2.1 The Reliability Availability Maintainability and Safety (RAMS) Plan shall be maintained as a live document and updated as necessary throughout the duration of the Project.

7.2.2 The RAMS Plan shall define the Contractor's approach on systematic compliance to relevant System Requirement Specifications, procedures and schedules for conducting the Reliability, Availability, Maintainability and Safety Engineering.

7.2.3 RAMS Plan shall describe the organization, resources and procedures that will be established to manage system assurance activities. It shall clearly defining the responsibilities of personnel directly associated with system assurance activities and implementation of the program.

7.2.4 The RAMS Plan will describe the RAM and Safety Assurance activities throughout the project lifecycle, comprising Design, Manufacturing & Production, Construction & Installation, Testing & Commissioning and Operation.

7.2.5 The RAMS Plan shall describing the procedures to perform the specific RAMS tasks necessary to meet Reliability, Availability, Maintainability and Safety requirements.

7.2.6 The RAMS Plan shall include application of the relevant standards, norms, regulations, instructions and the Employer's Requirements/ Specifications.

7.2.7 The Contractor shall liaise with the 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, Testing, Commissioning, Putting to work and Warranty monitoring to be undertaken in good time to meet the overall time scales of the project.

7.2.8 The Contractor shall submit a Compliance Matrix in the RAMS Plan with all phases mentioned above and tasks to be performed and the deliverables to be submitted for demonstration of compliance with RAMS requirements. These requirements shall also be applied to sub-contractors.

7.3 COMPLIANCE MANAGEMENT

A compliance management process shall be established and maintained for the duration of the Project to:

7.3.1 Import all RAMS requirements from the Project documents and ensure compliance to Technical Specifications and System Requirements Specifications

7.3.2 Import design requirements and specifications from each stage of design as they are developed and assess the impact of any changes in these

7.3.3 Provide traceability to demonstrate that high level and low level design requirements and specifications have been verified that they satisfy the RAMS requirements

7.3.4 Provide traceability of review comments made and the associated responses and follow up actions

7.3.5 Provide traceability of non-conformances and follow up actions required to address them

7.3.6 Provide traceability of validation of testing and commissioning results against RAMS requirements or design requirements and specifications

7.3.7 Provide summary reports on key status items including, but not limited to requirements not yet satisfied and incomplete or missing verifications or validations

7.4 VERIFICATION & VALIDATION

7.4.1 **Verification and Validation activities** shall be undertaken to show in a logical, progressive and traceable manner that the:

7.4.1.1 The designs satisfy the RAMS requirements

7.4.1.2 The completed works that have been subjected to testing and commissioning indeed demonstrate that they meet the RAMS requirements

7.4.2 Verification & Validation shall be carried out preferably by an engineering team who are independent from those carrying out the design.

7.4.3 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.

7.4.4 **Verification methods** shall include one or more of the following:

7.4.4.1 Analysis of design

7.4.4.2 RAM studies

7.4.4.3 Design safety studies

7.4.4.4 Simulations

7.4.4.5 Calculations

7.4.4.6 Benchmarking against international best practice where appropriate, and

7.4.4.7 other methods as appropriate.

7.4.5 Records of all verification and validation activities shall be kept and shall be traceable through the Compliance Management Process.

7.5 RAMS ORGANIZATION

7.5.1 The RAMS 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.

7.5.2 Alternately, the Contractor shall retain the services of a RAMS consultant to manage the entire scope of the RAMS work.

7.6 SYSTEM RAM MANAGEMENT

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.

7.6.1 RAM Activities

7.6.1.1 **Design Phase -** The RAM activities will include:

7.6.1.1.1 Develop detailed RAM allocations for subsystems, assemblies, and equipment.

7.6.1.1.2 Perform Reliability, Maintainability and Availability analyses at the Preliminary Design phase.

7.6.1.1.3 Perform detailed Reliability, Maintainability and Availability analysis and Prediction at the Final Design phase.

7.6.1.1.4 Perform Failure Mode, Effects and Criticality Analysis (FMECA)

7.6.1.1.5 Integrate RAM Design and Analysis results into Test planning, Maintenance planning, Maintenance manuals, and Operating manuals

7.6.1.1.6 Establish failure reporting, analysis, and corrective action system (FRACAS)

7.6.1.2 **Construction and Installation Phase** - The RAM activities will include:

7.6.1.2.1 Updating of Reliability, Maintainability and Availability analyses and Prediction

7.6.1.2.2 Updating FMECA

7.6.1.2.3 Preparation of Reliability, Maintainability and Availability Demonstration Plans

7.6.1.3 **Testing, Trials and Warranty Phase** - The RAM activities will include:

7.6.1.3.1 Perform RAM Demonstration

7.6.1.3.2 Execute a Failure Reporting and Corrective Action System (FRACAS)

7.6.1.3.3 Provide all necessary reports and documentation for tracking by the V&V process

Details of the above-mentioned RAM activities are enumerated in succeeding

sections.

7.6.2 **RAM Analysis and Prediction:**

7.6.2.1 Contractor will 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.

7.6.2.2 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.

7.6.2.3 Reliability will 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.

7.6.2.4 The RAM Analysis will also be used to identify and select service failures for in-depth assessment in the Fault Tree Analysis (FTA)

7.6.2.5 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

7.6.2.6 Reliability Predictions will 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

7.6.2.7 Reliability Predictions will 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, MILE HDBKE 217F Notice 2, Non electronic Parts Reliability Data (NPRD), Manufacturer Test data or any other well established industrial reliability prediction databases

7.6.2.8 The reliability predictions will be subject to confirmation during the Reliability Demonstration Test.

7.6.3 **Failure Mode, Effects, and Criticality Analysis (FMECA)**

7.6.3.1 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 system performance (performance of the immediate assembly and their entire system) and to provide an input to mitigating measures to reduce risk. FMECA will be performed and updated at different project stages until the task is concluded. The FMECA will be intended to:

7.6.3.1.1 Undertake decomposition of the System, Sub-systems from the highest level till the LRU level.

7.6.3.1.2 Provide the lowest level analysis of failures and failure effects on the system and its subsystems and equipment.

7.6.3.1.3 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.

7.6.3.1.4 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.

7.6.3.1.5 Identification of single failure points critical to proper system performance.

7.6.3.1.6 Provide early visibility into potential system interface problems.

7.6.3.2 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. The purpose of FMECA will be to identify:

7.6.3.2.1 Those failures which have unwanted effects on safety

7.6.3.2.2 Those failures which have unwanted effects on system operation

7.6.3.2.3 Those failures which have unwanted effects on overall reliability

7.6.3.2.4 To allow improvements of the systems safety

7.6.3.2.5 To allow improvements of the systems reliability

7.6.3.2.6 To allow improvement of the systems maintainability

7.6.3.2.7 To allow improvements in the systems availability

7.6.4 Reliability Critical Item List (RCIL)

7.6.4.1 The contractor will 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.

7.6.4.2 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.

7.6.5 Maintainability Analysis and Predictions

7.6.5.1 The Contractor will perform analytical maintainability analysis and prediction to assure compliance with the specific maintainability requirements and to ensure system performance.

7.6.5.2 Maintainability will 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.

7.6.5.3 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.

7.6.5.4 In all **availability calculations** the following access times shall be assumed:

7.6.5.4.1 1 Hour for Signalling equipment

7.6.5.4.2 2 Hours for Telecommunication equipment

7.6.5.5 In the Maintainability analysis, the contractor will 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).

7.6.5.6 The Contractor will 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.

7.7 SYSTEM SAFETY MANAGEMENT

7.7.1 Principle of Safety Management

7.7.1.1 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.

7.7.1.2 The basic principle of safety management shall be that all reasonably foreseeable hazards are identified and action then taken for each hazard as follows:

7.7.1.2.1 Risks arising from the hazard shall be assessed.

7.7.1.2.2 If the risk is broadly acceptable no further action shall be required, otherwise measures shall be taken to reduce or eliminate the risk.

7.7.1.2.3 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.

7.7.1.2.4 The mitigation, verification and validation status of all hazards shall be recorded in the Hazard Log.

7.7.2 **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;

(6) Management of safety during integrated testing, trials, and commercial operation.

7.7.3 **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.

7.7.4 **Hazard Analysis:** Hazard analysis shall be carried out to:

7.7.4.1 Identify and record all reasonably foreseeable hazards associated with all phases of the Works;

7.7.4.2 Assess the risk that each hazard represents to this operation; and

7.7.4.3 Re-assess the risk after application of the proposed mitigation.

7.7.5 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:

7.7.5.1 Minimized through mitigation measures at the design stage;

7.7.5.2 Mitigated through special construction, installation and testing and commissioning

processes; and

7.7.5.3 Mitigated through operations and maintenance procedures.

7.7.5.4 Additional mitigation measures shall be proposed as required until such time as the residual risk is assessed to be 'as low as reasonably practicable'.

7.7.5.5 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.

7.7.6 Primary hazards for **Preliminary Hazard Analysis (PHA):** The PHA shall take into account, but not be limited to, the following primary hazards:

7.7.6.1 fire including:

7.7.6.1.1 smoke asphyxiation;

7.7.6.1.2 hot works; and

7.7.6.1.3 explosion;

7.7.6.2 Impact including:

7.7.6.2.1 collision;

7.7.6.2.2 derailment;

7.7.6.2.3 falling objects;

7.7.6.2.4 flying objects;

7.7.6.2.5 sharp objects;

7.7.6.2.6 slipping, tripping and falling;

7.7.6.2.7 electrocution;

7.7.6.3 Other hazards including:

7.7.6.3.1 environmental;

7.7.6.3.2 flooding;

7.7.6.3.3 noxious fumes;

7.7.6.3.4 suffocation;

7.7.6.3.5 entrapment; and

7.7.6.3.6 burns.

7.7.6.4 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:

7.7.6.4.1 freight service;

7.7.6.4.2 evacuation; and

7.7.6.4.3 maintenance.

7.7.6.5 **The PHA** shall take into account how each type of hazard might arise including, but

not limited to:

7.7.6.5.1 inappropriate design or specification;

7.7.6.5.2 equipment failure;

7.7.6.5.3 installation error;

7.7.6.5.4 improper action (accidental or deliberate);

7.7.6.5.5 inaction (unintentional or intentional); and

7.7.6.5.6 external influence.

7.7.6.6 **The PHA** will be followed by detailed hazard analysis:-

7.7.6.6.1 Sub System Hazard Analysis (SSHA)

7.7.6.6.2 Interface Hazard Analysis (IHA)

7.7.6.6.3 Operating and Support Hazard Analysis (O&SHA)

7.7.6.7 **The Hazard analysis** will be supported by following assessment methods:

7.7.6.7.1 Failure Mode, Effects and Criticality Analysis (FMECA)

7.7.6.7.2 Fault Tree Analysis (FTA) of top level hazard scenarios

7.7.7 **Design Safety Studies and Report**

7.7.7.1 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.

7.7.7.2 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.

7.7.7.3 **Design Safety Studies** shall specifically refer to hazards arising from:

7.7.7.3.1 normal operations including maintenance;

7.7.7.3.2 degraded modes of operation;

7.7.7.3.3 emergency situations; and

7.7.7.3.4 the effectiveness of mitigation proposed for natural catastrophes.

7.7.7.4 The **Design Safety Studies** shall take account of:

7.7.7.4.1 Methods of operation;

7.7.7.4.2 RAM considerations;

7.7.7.4.3 Anticipated likely maintenance regimes and their sustainability in Commercial Operation;

7.7.7.4.4 Anticipated competence levels of personnel in Commercial Operation;

7.7.7.4.5 Software security (disabling of unauthorized access to operating systems, protection against intrusive attacks, loss of password integrity, etc.); and

7.7.7.4.6 Other human factors including but not limited to those identified in ergonomic studies.

7.7.7.5 **Design/ Systems Safety Studies and the Report** shall demonstrate, as a minimum, the following requirements:-

7.7.7.5.1 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.

7.7.7.5.2 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".

7.7.7.5.3 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.

7.7.7.5.4 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.

7.7.7.5.5 That robust processes have been implemented to validate the Safety Critical aspects of software design.

7.7.7.5.6 That processes for assessing the potential safety impact of design changes exist.

7.7.7.5.7 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.

7.8 RAM DEMONSTRATION

7.8.1 Reliability Demonstration

7.8.1.1 The Contractor will perform a Reliability Demonstration to verify that the system meets the required reliability performance requirements when:

7.8.1.1.1 Scheduled maintenance is performed in accordance with approved Maintenance Plan and Maintenance Manuals, and

7.8.1.1.2 Systems are operated within the environmental limits described in the Design documents.

7.8.1.2 The demonstration of the system will 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.

7.8.1.3 The Contractor will submit a **RAM Demonstration Test Plan** before the Final Design Review. The plan will address the following to illustrate compliance with the reliability requirements:

7.8.1.3.1 Plan schedule and period

7.8.1.3.2 Identification of necessary facility, resources, support equipment, and staff for the demonstration

7.8.1.3.3 RDT procedures and forms for recording and submitting data

7.8.1.3.4 Success failure criteria for measuring reliability values for individual equipment items and subsystems

7.8.1.3.5 Failure analysis of reported failures to identify the cause and need for corrective action

7.8.1.3.6 Establish a Failure Review Board (FRB) to meet with Employer, as required, to determine the need and depth of failure analyses

7.8.1.3.7 Change control procedures for implementing design changes

7.8.1.3.8 Format and location of test records, test logs, and data records

7.8.1.3.9 Final conclusion and report for the demonstration.

7.8.1.4 The Employer will approve the RAM Demonstration Plan and procedures before the trial commences.

7.8.1.5 The **RAM Demonstration Procedures** will include all information necessary to ensure the successful, accurate and safe performance of the demonstration testing. The RAM Demonstration Procedures will include, as required:

7.8.1.5.1 Safety Precautions

7.8.1.5.2 Identification of the reliability performance parameters that are verified by the test

7.8.1.5.3 Scope of test

7.8.1.5.4 Test equipment requirement if any

7.8.1.5.5 Personnel required

7.8.1.5.6 Any special conditions required, including condition of the equipment under test

7.8.1.5.7 Reference drawings or documents

7.8.1.5.8 Clear pass/fail criteria

7.8.1.5.9 Data sheets to record test results

7.8.1.5.10 Raw data correlation procedure

7.8.1.6 **RAM demonstration procedure** will address the following:

7.8.1.6.1 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.

7.8.1.6.2 A proposed procedure for corrective action will 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).

7.8.1.6.3 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.

7.8.1.6.4 System suppliers will 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 will provide failure records to employer in hard copy and in an approved electronic format.

7.8.1.7 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.

7.8.1.8 **Non-chargeable failures in the RAM Demonstration** are:

7.8.1.8.1 Consumable items, except for those which are not achieving their specified life

7.8.1.8.2 A failure occurrence in equipment of another subsystem, due to the primary failure

7.8.1.8.3 A failure of the operator/ maintainer to perform recommended preventive maintenance actions

7.8.1.8.4 Vandalism or physical mistreatment at a human interface

7.8.1.8.5 Failures due to an accident.

7.8.1.9 The Contractor will provide Weekly Failure Reports during the RAM Demonstration phase. The Contractor will submit the format and structure of the report to the Engineer

for review and approval at least three months before system commissioning begins.

7.8.1.10 The Contractor will submit Monthly Demonstration Test Reports to the Engineer documenting the current and cumulative failure totals for the system equipment, comparing the totals to the reliability requirements.

7.8.2 **Availability Demonstration**

7.8.2.1 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.

7.8.2.2 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.

7.8.2.3 In the event that the availability target is not achieved, the Contractor shall, at his own expense, take whatever action as deemed necessary to meet the availability requirement.

7.8.2.4 The contractor will submit the Availability Demonstration Test Report on completion of the demonstration testing.

7.8.3 **Maintainability Demonstration**

7.8.3.1 The Contractor will 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. The Contractor will perform the MD concurrent with the HORC personnel training program. The Contractor and S&T System/ Sub-system Supplier(s) 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. HORC will notify System Suppliers which preventive and corrective maintenance tasks have been selected for the MD.

7.8.3.2 Maintainability Demonstration Test Plan will be provided before the Final Design Review.

7.8.3.3 In the event that any maintainability target is not achieved, the Contractor shall at his own expense take action as required to meet the maintainability targets.

7.8.3.4 The contractor will submit a Maintainability Demonstration Test Report on completion of the demonstration testing.

7.9 FAILURE REPORTING AND CORRECTIVE ACTION SYSTEM

7.9.1 Purpose of Failure Reporting and Corrective Action System (FRACAS): The Contractor will provide a Failure Reporting and Corrective Action System (FRACAS) that supports requirements of the RAM Demonstration and Warranty Program. The contractor will submit the FRACAS for the Engineer's approval before the Final Design Review. The 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 are to:

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.

7.9.1 Where system failures indicate the possibility of a non-compliant design, the FRACAS process will consist of the following activities:

7.9.1.1 Communication of failure information from the operating authority to the S&T System Suppliers

7.9.1.2 Assessment of the failure conditions, impacts, and possible causes by the S&T System, Supplier Quality Assurance, Electrical and Engineering departments, and by equipment suppliers

7.9.1.3 Where appropriate failure analysis by the equipment supplier

7.9.1.4 Corrective action by the equipment supplier

7.9.1.5 Once corrective action has been completed through field or factory action, verification by the System Supplier that the implemented solution is adequate and acceptable.

7.9.2 FRACAS Guidelines:

7.9.2.1 A comprehensive FRACAS closed loop diagram is shown below:

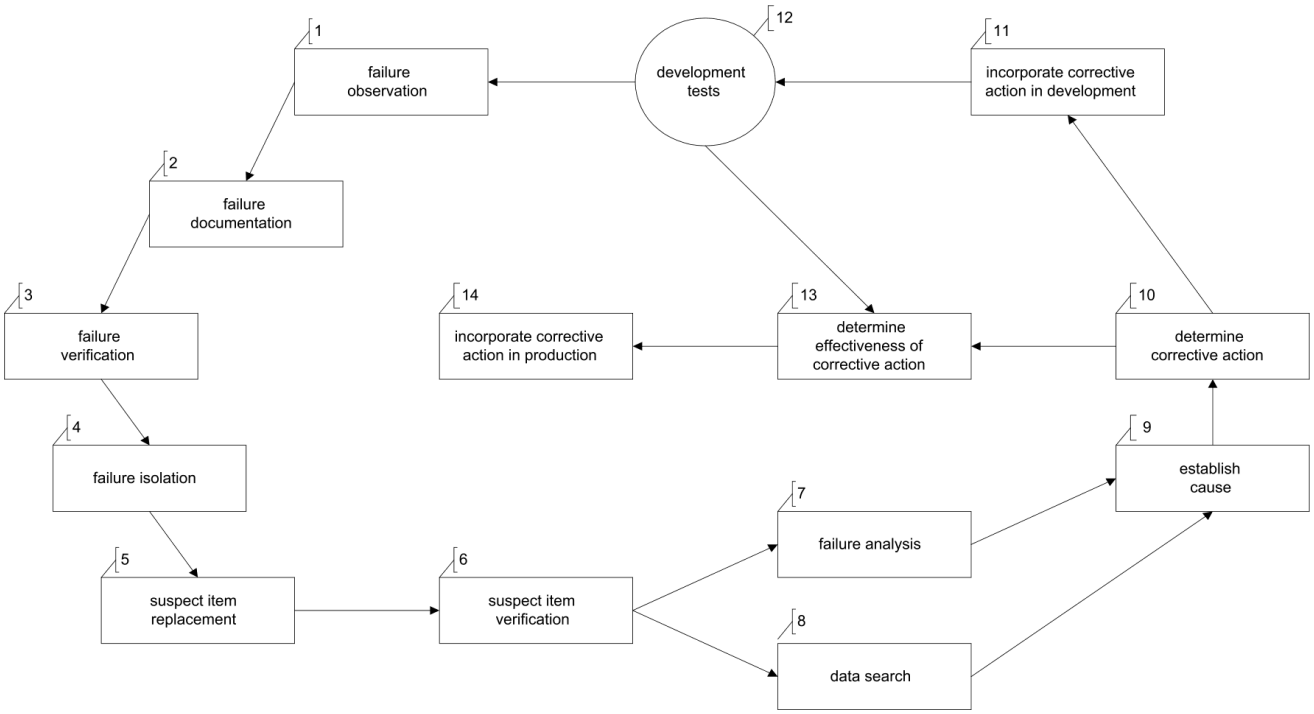


Figure 1: Generic Closed-Loop FRACAS

7.9.2.2 Key steps in FRACAS are as follows:

7.9.2.2.1 Observation of failure: Complete documentation of failure including all significant conditions which existed at the time of the failure

a) Failure verification, i.e. confirmation of the validity of the initial failure observation

b) Failure isolation, localization to the lowest replaceable defective item within the product

c) Replacement of the suspect defective item

d) Confirmation that the suspect item is defective

e) Failure analysis of the defective item

f) Data search to uncover other similar failure occurrences and to determine the previous history of the defective item and similar related items

g) Establishment of the root cause of the failure

h) Determination, by the design team, of the necessary corrective action, especially any applicable redesign

i) Incorporation of the recommended corrective action into development equipment

j) Establishment of the effectiveness of the proposed corrective action

k) Incorporation of effective corrective action into the equipment

l) The failure documentation should be augmented with the verification of failure and verification that the suspect part did indeed fail.

7.9.2.2.2 Reporting of Failure: All failures shall be recorded on a failure report form which shall contain as a minimum the following information:

a) Identification of the equipment, including nomenclature, serial number, manufacturer's part number and location;

b) Location of failure;

c) Individual who observed failure;

d) Operating time of each system including each shut-down and its cause;

e) Date and time of each incident;

f) Failure symptom/ indication, mode, cause and effect;

g) Classification of the incident (relevant independent failure or dependent failure);

h) Corrective maintenance or operational procedures required to restore the System to operation;

i) Time to restore System to operation and active repair time; and

j) Circumstances of interest such as Environmental conditions and supply voltages.

7.9.3 Failure Database

7.9.3.1 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.

7.9.4 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 Engineer at the expiry of the Defects Liability Period.

7.10 FIELD TESTING AND INTEGRATED SYSTEM TESTING

The **On-site Testing and Integrated System Testing** shall demonstrate as a minimum the following requirements:

7.10.1 That the safety management organisation to control the on-site Testing and Integrated System Testing is in place.

7.10.2 The testing procedures shall ensure that all the critical failure modes as identified during the Failure, mode, effects and criticality analysis (FMECA)/ Failure, mode, effect analysis (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 a sensitive analysis or other means that the impact of a failure mode on reliability and maintainability will be insignificant.

7.10.3 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.

7.10.4 That the segregation of on-site Testing and Integrated System Testing activities from residual construction and installation activities shall be implemented.

7.10.5 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.

7.10.6 That the processes which are to be implemented to validate the Safety Critical aspects of software installation and testing shall be implemented.

7.10.7 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.

7.10.8 That the arrangements which are to be utilised to record, report and investigate accidents and incidents together with the systems necessary to formulate and implement measures to prevent reoccurrence shall be implemented.

7.10.9 That effective controls shall be implemented in respect of the activities of all other contractors, relevant authorities and third parties.

7.11 ENGINEERING SAFETY VALIDATION PLAN

7.11.1 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.

7.11.2 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.

7.11.3 **Validation of the correct implementation of all safety design criteria** shall be demonstrated by submitting details including:

7.11.3.1 a cross reference to the program of safety validations;

7.11.3.2 the purpose of each validation;

7.11.3.3 the method of each validation;

7.11.3.4 the qualifications of staff performing the validation;

7.11.3.5 the names of witnesses to the validation;

7.11.3.6 the acceptance criteria for each validation;

7.11.3.7 the results of each validation;

7.11.3.8 analysis of validation results to show that they confirm requirements have been met; and

7.11.3.9 the recommended procedure for the correction of deficiencies observed during the validation process and the steps required to repeat the validation.

7.12 OPERATIONAL SAFETY CASE

7.12.1 General Requirements: In order to demonstrate that the system will 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.

7.12.2 The **Operational Safety Case** shall typically consist of but not be limited to the following:

7.12.2.1 Executive Summary;

7.12.2.1.1 Introduction;

7.12.2.1.2 Definition of System;

7.12.2.2 Quality Management Report;

7.12.2.3 Safety Management Report;

7.12.2.3.1 Introduction;

7.12.2.3.2 Roles and Responsibilities;

7.12.2.3.3 Safety Lifecycle;

7.12.2.3.4 Safety Requirements;

7.12.2.3.5 Safety Standards;

7.12.2.3.6 Safety Audit and Assessment;

7.12.2.3.7 Supplier Management;

7.12.2.3.8 Safety Controls;

7.12.2.3.9 Configuration Management; and

7.12.2.3.10 Project Safety Training.

7.12.2.4 Technical Safety Report

7.12.2.4.1 Introduction;

7.12.2.4.2 Assurance of correct functional operation;

7.12.2.4.3 Effects of faults;

7.12.2.4.4 Operation with External Influences;

7.12.2.4.5 Safety-related application conditions;

7.12.2.4.6 Safety Qualification tests; and

7.12.2.4.7 Other Outstanding Safety Issues.

7.12.3 **Conclusion:** 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:

7.12.3.1 System Management Plan;

7.12.3.2 System Safety Plan;

7.12.3.3 System Operating Safety Plan;

7.12.3.4 System Operating Plan;

7.12.3.5 System Assurance Plan;

7.12.3.6 Emergency Preparedness and Fault Recovery Plan;

7.12.3.7 Rules and Procedures;

7.12.3.7.1 Indian Railways Rules and Procedures; and

7.12.3.7.2 Health and Safety Regulations.

7.13 PROOF OF SAFETY

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:

7.13.1 That the Signalling & Telecommunication system 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.

7.13.2 That the recommended safety performance criteria and safety thresholds for the safe operation and maintenance of the Works have been met.

7.13.3 That the standards and specifications upon which the safe operation and maintenance of the Works are based have been met.

7.13.4 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.

7.14 TRIAL RUNNING

Activities: The period of Trial Running shall include as a minimum the following activities:

7.14.1 Demonstration of system performance and adherence to timetables during Trial Run.

7.14.2 Evaluation of the effectiveness of normal operating procedures including those that deal with minor disruptions and staff unavailability.

7.14.3 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.

7.14.4 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.

7.15 REVENUE SERVICE RUNNING

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:

7.15.1 Revenue Service shall not commence until the "Proof of Safety" has received the approval of the Employer.

7.15.2 During the Defects Notification Period, day to day monitoring of the RAM performance

shall be carried out and the findings shall be used for recording of the RAM performance.

7.15.3 In the event that a defect/ failure arises, the Contractor shall provide full Technical support in Failure investigation and rectification.

7.15.4 The Contractor shall employ suitable mechanisms and develop a suitable organization structure in conjunction with the Employer to support ongoing RAM activities.

7.15.5 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.

(End of Chapter-7)

CHAPTER 8 — TRAINING

8.1 GENERAL

8.1.1 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. The Contractor shall arrange Training at Manufacturing facilities as well as at site as per the approved Training Plan.

8.1.2 All the training courses at manufacturing facilities shall be conducted during design period and completed before the commencement of installation.

8.1.3 The Training at manufacturing facilities has the potential of imparting maximum benefit and shall cover all Telecommunication equipment provided under the contract.

8.1.4 All the Training Courses at site shall be conducted during installation period and shall be completed before the commencement of Testing and Commissioning.

8.1.5 The Contractor shall also arrange training at site for Employer's Maintenance and Operating personnel and Key Instructors. The Contractor shall set up Training Class rooms near to site, where he shall provide competent Training instructors, Training manuals, all necessary aids and materials as required for all the Training courses. The Training courses shall cover Working principles, Installation, Operation, Fault Diagnosis & Maintenance of all major equipment and Works engineered by the Contractor.

8.1.6 The Training instructors shall be qualified, competent, with sufficient years of practical experience in the relevant fields. The Training instructors shall be either the System designer or Engineering staff of the Contractor, the Contractor's subcontractors or the equipment manufacturers. No Training instructor shall be deployed without prior approval of the Engineer. The training shall be in English and Hindi languages as required. The Training abroad shall, however, be in English language only. All Training material shall be provided in English. If requested by the Engineer, the Training material shall be provided in Hindi also.

8.1.7 The Employer intend to create some 'Experts' of each sub-system/ equipment who need to be intensively trained by the Contractor in all aspects (Design, Installation, Testing and Commissioning, Fault finding etc.) of each sub-system/equipment and train them to the level that they can even undertake customization of the sub system as required by the Employer from time to time in future. The Employer will nominate up to 5 persons for training in each sub-system.

8.1.8 The Training Program shall enable the basic staff to operate service, to enhance, to maintain and to interact with the hardware, software and firmware such that the systems and associated equipment will perform in accordance with the specifications of this contract.

8.1.9 The Training courses and/ or sessions shall include system performance requirements and all major equipment and works engineered by the Contractor.

8.1.10 The Contractor shall submit assessment reports on the performance of individual trainees to the Engineer. Training evaluation shall be required at regular intervals to monitor the progress and suitability of the training program. 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,

8.1.11 The Contractor shall bear all the training costs except for allowances, hotel and travel expenses of the Employer's trainees.

8.1.12 Throughout training program, the Engineer/ Employer shall have free access to all training sessions to monitor the progress of the trainees and the Contractor's training instructors.

8.1.13 If required by the Employer, any one or more of training courses may be repeated during currency of the contract to train additional batches of staff.

8.1.14 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.

8.2 SCOPE OF TRAINING

Objective of Training is as follows but not limited to:

8.1.15 To enable the Employer's maintenance personnel to maintain the commissioned Signallling & Telecommunication systems;

8.1.16 To enable the Employer's Operating personnel to become competent in operating the various systems/ sub-systems at work site; and

8.1.17 To enable the Employer's Key Instructors to become competent to deliver future courses to other employees of the Employer;

8.1.18 The Training shall be imparted on various Sub-systems. Aspects covered shall include, but not be limited to the following:

8.1.19 Operating features and functional principles of the relevant Systems.

8.1.20 System engineering aspects including Design standards, Design criteria and Parameters, Short-circuit and Other calculations, Insulation and Protection co- ordination.

8.1.21 Details of major equipment and components used in the System.

8.1.22 System operating and maintenance management procedures and

8.1.23 Control and monitoring systems for each System.

8.1.24 The Training shall be in India and abroad, including training at manufacturing facilities as appropriate.

8.3 TRAINING PLAN

Within **Six months** after the Commencement Date of the Works, the Contractor shall submit a Training Plan to the Engineer for review. The Training Plan shall include, but not be limited to, the following:

8.3.1 The program of the training courses at site and at manufacturing facilities.

8.3.2 Overview and description of objectives of each training course.

8.3.3 The location where the training courses to be conducted;

8.3.4 Submission schedule of the Training materials;

8.3.5 Set ups for practical exercises;

8.3.6 The Contractor's training organisation chart including the role and responsibilities of individual key persons;

8.3.7 The qualifications and experience of the training instructors;

8.4 TRAINING COURSES FOR SIGNALLING & TELECOMMUNICATION SUB-SYSTEM

8.4.1 General

8.4.1.1 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.

8.4.1.2 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.

8.4.1.3 Training at site shall include Operation courses and Maintenance courses. The class will be of maximum of 30 Trainees. The Contractor in consultation with the Engineer and the 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.

8.4.2 Training Courses for Operating Staff:

The Training courses for Operating personnel on Telecommunication systems/sub-systems shall be developed to provide all necessary knowledge and skills that enable them to operate 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:

8.4.2.1 Overview of the system/sub-system;

8.4.2.2 Brief description of the operational principles of the system/sub-systems;

8.4.2.3 Operational features and functions;

8.4.2.4 Familiarisation and use of all man-machine interfaces involved;

8.4.2.5 Reading and interpretation of system status and alarm messages or indications;

8.4.2.6 Normal operating procedures;

8.4.2.7 Operating procedures under emergency situations;

8.4.2.8 Procedures for recovery from minor or simple faults.

8.4.2.9 A comprehensive list of Dos and Don'ts shall be prepared and explained to the Operating personnel and also shall be prominently displayed at the stations.

8.4.3 Training Courses 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:

8.4.3.1 Planned maintenance and overhaul of all the railway systems/subsystems supplied, installed or modified under the Contract;

8.4.3.2 Fault diagnosis 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;

8.4.3.3 Normal and degraded modes of operation of the S&T systems/subsystems including equipment supplied, installed or modified under the Contract;

8.4.3.4 All rules, regulations, practices and procedures necessary for the safe and efficient operation of the S&T systems/subsystems supplied, installed or modified under the Contract; and

8.4.3.5 All contingency plans necessary to recover speedily and safely from any mishaps or emergencies that may arise with the S&T systems/subsystems supplied, installed or modified under the Contract.

8.4.3.6 The Training in Operation and Maintenance shall enable trainees to obtain competence, including obtaining Competency Certificate from the competent authority.

8.4.3.7 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.

8.4.3.8 The Contractor shall determine the content of the system engineering courses, however the **courses** shall include the following as minimum:

8.4.3.8.1 Overview of the S&T systems/subsystems;

8.4.3.8.2 Brief description of the operation principles of the Sub-systems and background theory;

8.4.3.8.3 System/ operational features and functions;

8.4.3.8.4 Description of system components and equipment down to card or module level;

8.4.3.8.5 Test and commissioning procedures;

8.4.3.8.6 Use of Test equipment and Special tools;

8.4.3.8.7 Reading and interpretation of alarm indications, messages and print-outs;

8.4.3.8.8 Preventive maintenance procedures;

8.4.3.8.9 Fault diagnosis, Troubleshooting and Corrective maintenance procedures;

8.4.3.8.10 Equipment settings and Parameters configuration;

8.4.3.8.11 Use of Equipment manuals, Operation and Maintenance manuals, Circuit diagrams and Wiring schematics;

8.4.3.8.12 Methods and procedures to provide new circuits, System expansion and Enhancement;

8.4.3.8.13 Data, software backup and loading;

8.4.3.8.14 Use of software such as peripheral control and configuration, utility, database structure, generation and modification;

8.4.3.8.15 Periodical Maintenance schedules and impacts;

8.4.3.8.16 Familiarisation and use of all man-machine interfaces involved;

8.4.3.8.17 Normal operating procedures;

8.4.3.8.18 Operating procedures under emergency situations; and

8.4.3.8.19 Procedures for recovery from faults

8.4.3.9 During the Defects Notification Period, when the Contractor is responsible for fault finding and repair, he shall provide practical hands on training to Employer's maintenance staff to facilitate successful handing over of the works.

8.4.3.10 Training Courses for Signalling & Telecommunication Sub-Systems:

The Maintenance & Troubleshooting Courses shall be developed to provide all necessary knowledge and skills for maintenance staff of the Employer to perform full maintenance, including both preventive and corrective maintenance and fault diagnosis in case of failure. The Contractor shall provide training courses for each of the Signalling & Telecommunication sub-systems including but not limited to:

8.4.3.10.1 Signalling Sub-System:

8.4.3.10.1.1 Distributed Architecture with Object Controllers of Electronic Interlocking (EI).

8.4.3.10.1.2 Power Supply System (Auto changeover, IPS, Batteries etc.)

8.4.3.10.1.3 High availability single section digital axle counter (HASSDAC).

8.4.3.10.1.4 Block Instrument with Block panel

8.4.3.10.1.5 Data Logger System/ Remote diagnostic and predictive maintenance system (RDPM)

8.4.3.10.1.6 Electric Point machines

8.4.3.10.1.7 Signalling Cables

8.4.3.10.1.8 Earth leakage detector

8.4.3.10.1.9 Earthing and Surge Protection Systems for Signalling system

8.4.3.10.1.10 Installation of signalling system

8.4.3.10.1.11 Testing & commissioning of signalling system

8.4.3.10.1.12 Any other sub system as PS (Signalling)

8.4.3.10.2 Telecommunication Sub-system

8.4.3.10.2.1 Optic Fiber Communication System, Splicing and Testing.

8.4.3.10.2.2 Quad cable communication system

8.4.3.10.2.3 DTMF Train Control Communication System

8.4.3.10.2.4 Emergency communication system

8.4.3.10.2.5 Digital/ISDN and VoIP based EPABX system and Attendant console

8.4.3.10.2.6 Telecommunication Power Supply System

8.4.3.10.2.7 Telecommunication cables

8.4.3.10.2.8 Earthing and Surge Protection System for Telecom equipment

8.4.3.10.2.9 Installation

8.4.3.10.2.10 Testing & Commissioning

8.4.3.10.2.11 Any other sub system as PS (Telecommunication)

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.

8.5 TRAINING MATERIAL AND EQUIPMENT

8.5.1 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.

8.5.2 The Contractor shall arrange all training materials including tables, chairs, white boards, and so on. If available, the Contractor may however, use the training rooms of the Employer.

8.5.3 With the prior approval of the Engineer, the Contractor may use the Works being erected, tested or commissioned for the training of Employer's Personnel.

8.5.4 The Contractor shall prepare a Trainer's guide for each training course. The Trainer's 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.

8.5.5 At the commencement of the Training course, the Contractor shall distribute Two sets of Trainer's guides and One set of Training manual for each trainee and Three additional sets of Training manual to the Engineer

8.5.6 Training course notes shall be compatible and where appropriate, cross-referenced to the Manuals supplied by the Contractor as part of the Operation and Maintenance documentation.

8.5.7 The Training course notes and Trainer's guides shall be submitted to the Engineer for review **six (06) months prior** to the commencement of the first training session of the course. Course notes and Trainer's guides shall be in a standard format as decided by the Engineer and in a form that allows for easy reproduction. At least two months before the commencement of the Training course, the Contractor shall submit all the Training materials including the Trainer's guides, Training manual for trainees, Training aids and Presentation materials to the Engineer for review. The Training materials shall be prepared in a form allow easy future reproduction.

8.6 TEST AND ASSESSMENT

8.6.1 The Contractor shall develop a system of assessment and certification of trainees at the end of each course. The system of assessment shall test the knowledge, understanding and proficiency of the trainees.

8.6.2 The assessment and certification procedures shall be submitted by the Contractor for approval of the Engineer.

8.6.3 At the end of the Training period, the Contractor shall issue Training certificate to the Trainees who pass the assessment.

8.6.4 Training sessions, Tests, and Certification processes may be witnessed by the Engineer and the Employer.

8.6.5 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 after the commencement of the Training course.

8.7 TRAINING RECORDS

8.7.1 The Contractor shall keep attendance records of trainees.

8.7.2 The Contractor shall issue appropriate Training certificate to the trainees who pass the assessment.

8.7.3 The Contractor shall, at the completion of each training course provide the Engineer a consolidated training records listing the Training course title, Date of training, Name of all trainees, Training result and other relevant information.

8.7.4 After two weeks, the Contractor shall submit a Training report to the Engineer for review.

8.7.5 The Training report shall include a summary of the training course conducted, the results of trainees' assessment and the Feedback report.

(End of Chapter-8)

CHAPTER 9 — OPERATION & MAINTENANCE AND SERVICE LIFE SUPPORT

9.1 GENERAL

9.1.1 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.

9.1.2 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.

9.1.3 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 include equipment being provided under this Contract Package and upgraded/augmented/reconfigured.

9.1.4 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.

9.2 OPERATION AND MAINTENANCE SUPPORT PLAN

Operation and Maintenance Support Plan shall cover, but not limited to, the following items:

9.2.1 Submission of Technical Manuals as required for both Signalling and Telecommunication system;

9.2.2 Submission of Operation & Maintenance Manuals and Warranty certificates for each item/unit/ equipment to the Employer.

9.2.3 Requirement of bare minimum Employer's Manpower for maintenance.

9.2.4 Proposed Contractor's Manpower for supervision of Maintenance for one year Maintenance and Defect Notification Period;

9.2.5 Provision of Software support during one year Maintenance and Defect Notification Period;

9.2.6 Provision of Spares, Test Equipment, Tools, etc. for respective equipment and machines;

9.2.7 Requirement of periodic operation of equipment and machines which would otherwise deteriorate because of non-operation for extended periods.

9.3 SUPPORT DURING ONE YEAR MAINTENANCE AND DEFECT NOTIFICATION PERIOD (DNP)

9.3.1 Support and Call-out Services

9.3.1.1 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.**

9.3.1.2 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 of Signalling and Telecommunication System shall be provided by the contractor. All the resources shall be trained before deployment.

9.3.1.3 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.

9.3.1.4 The Contractor's response Time for Support & Call-Out-Services shall not exceed three hours for Signalling and Telecommunication both. 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.

9.3.1.5 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.

9.3.2 **Repair**

9.3.2.1 The Contractor shall provide 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.

9.3.2.2 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.

9.3.2.3 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.

9.3.2.4 The maximum turnaround time for 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.

9.4 RAMS TARGETS FAILURES

In case of failure of the Contractor to achieve the RAMS Targets specified in the Employer's Requirement:

9.4.1 The Defects Notification Period shall stand extended for a further periodcorresponding to period of failure;

9.4.2 The Performance Guarantee shall stand extended for a period corresponding to the extension of the Defects Notification Period; and

9.4.3 All works required to be carried out by the Contractor for the rectification of defects, shall be carried out at the Contractor's own expense.

9.5 OPERATION AND MAINTENANCE MANUALS

9.5.1 In addition to the various existing Codes and Manuals applicable to Indian Railways for operation and maintenance of systems, 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.

9.5.2 With reference to the requirements as above, 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 equipment/sub-systems:

9.5.2.1 Signalling System:

- Distributed Architecture with Object Controllers of Electronic Interlocking (EI).
- Power Supply System (Auto changeover, IPS, Batteries etc.)
- High availability single section digital axle counter (HASSDAC).
- Block Instrument with Block panel
- Data Logger System/ Remote diagnostic and predictive maintenance system (RDPM)
- Electric Point machines
- Signalling Cables
- Earth leakage detector
- Earthing and Surge Protection Systems for Signalling system
- Any other sub system as PS (Signalling)

9.5.2.2 Telecommunication System:

- Optic Fiber Communication System, Splicing and Testing.
- Quad cable communication system
- DTMF Train Control Communication System and Emergency communication system
- Digital/ISDN and VoIP based EPABX system and Attendant console
- Telecommunication Power Supply System
- Telecommunication cables
- Earthing and Surge Protection System for Telecom equipment
- Any other sub system as PS (Telecommunication)

9.5.3 **System/Sub-System Manuals-** A comprehensive description of all system principles shall be given at Block diagram level. It shall consist of following but not limited to:

9.5.3.1 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. The Operating Manual of EI shall contain detailed description of all the operations of the SM's Control terminal with coloured illustrations.

9.5.3.2 Workshop Manuals - Installation and Circuit descriptions, Full schematics, Circuits, Wiring diagrams, Mechanical Construction/ Installation drawings and itemised parts list to enable all maintenance rectification and setting-up to be carried out.

9.5.3.3 Software System Manual - For each software package and each piece of equipment which incorporates Programmable Device(s), Licensed copies of CD/DVD 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.

9.6 MAINTENANCE PLAN

9.6.1 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 **3 months before** start of Defect Notification Period.

9.6.2 The Maintenance Plan shall describe, but not limited to, the following:

9.6.2.1 Maintenance philosophy and approach

9.6.2.2 All necessary tasks for first line, second line, third line and corrective maintenance

9.6.2.3 Frequency of each maintenance task

9.6.2.4 Employer's and Contractor's proposed maintenance regime for maintenance

9.6.2.5 Maintenance Schedules (Daily, Weekly, Monthly as recommended by OEM) detailing maintenance task for each maintenance team member

9.6.3 The Maintenance Plan shall be aligned with the Employer's maintenance policy.

9.7 MAINTENANCE SCHEDULES

9.7.1 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.

9.7.2 In addition to the above, the Contractor shall include in the Maintenance Schedule the following information:

9.7.2.1 The equipment, sub-systems covered in the task,

9.7.2.2 Step by step procedure to carry out the task,

9.7.2.3 Tools and Test equipment required for each task,

9.7.2.4 Diagrams and Flowcharts by illustration, if applicable,

9.7.2.5 Adjustment procedures for all field adjustable units,

9.7.2.6 Recovery procedures, if applicable,

9.7.2.7 Precautions including Safety to be followed by maintenance personnel and

9.7.2.8 Estimated duration and manpower required;

9.8 MAINTENANCE MANUAL

The **maintenance manual** shall contain the following, but not limited to:

9.8.1 Technical description of each system and sub-system of equipment installed to ensure that the Employer's Technical staff fully understand the scope and facilities provided.

9.8.2 Diagrammatic drawings of each system indicating principal components and items of equipment.

9.8.3 Name, addresses, telephone, e-mail and fax numbers of the manufacturer of every item of equipment.

9.8.4 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.

9.8.5 Procedures for fault location and isolation.

9.8.6 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 Signal maintainer. It should lead to computerization of the maintenance activities.

9.8.7 Tools and Plant needed for maintenance of different equipment provided in the Works.

9.8.8 Configuration manual for all equipment, wherever required:

9.8.9 All test results conducted on the relevant equipment whether at the manufacturer's place or at site; and

9.8.10 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.

9.8.11 The Contractor shall submit all the Manuals for review by the Engineer prior to Factory Acceptance Tests which shall be submitted not later than 112 days before the targeted date of start of Trial Running for the Engineer's consent.

9.8.12 The Contractor shall provide sufficient copies of all Manuals along with electronic version for use of the Employer's Staff/Engineer.

9.8.13 The Contractor shall maintain all Manuals in an up-to-date condition throughout the Contract Period, wherever applicable.

9.9 SOFTWARE SUPPORT

9.9.1 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, bug fixes, updates, modifications, amendments and new versions of the program as required by the Engineer.

9.9.2 The changes and modifications of the software shall not degrade the performance or have adverse impact on the system. The Contractor shall maintain backup copies of all software developed or delivered for the System.

9.9.3 The Contractor shall ensure that all new versions are fully tested and validated and reviewed without objection by the Engineer prior to loading into the system.

9.9.4 The Contractor shall provide training to the Employer's staff for use of new version, as and when incorporated.

9.9.5 The Contractor shall provide full support to the Employer and Engineer for all computer programs provided by the Contractor under the Contract.

9.9.6 The Contractor shall provide all Tools, Equipment, Manuals, Configuration and Customization data and Training necessary for the Employer's staff to maintain and re-configure all the software provided under the Contract. This shall include supply of any specified development tools required for maintenance of the software, including, but not limited to, editors, compilers and linkers.

9.9.7 The Contractor shall submit all new versions to the Engineer for review at least **two (02) weeks prior** to their installation. 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. The Contractor shall:

9.9.7.1 ensure that all new versions are fully tested and validated on the simulation and development system prior to installation.

9.9.7.2 ensure that all new versions are fully tested and commissioned once installed on the site; and deliver to the Employer any new version, together with the updated Operation and Maintenance Manuals.

9.9.7.3 All new version of software shall be accompanied by a release note containing the following details:

- Version number
- Modifications made to the previous version.
- Check sum

9.9.8 The Engineer shall not be obliged to use any new version that shall not relieve the Contractor of any of its obligations. 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's attention including updating the files to suit new version.

9.10 SECURITY OBLIGATIONS

Within fourteen (14) days of the installation of any software, which is developed or modified for this Contract, into the permanent works by the Contractor, the Contractor shall submit to the Engineer for retention by the Employer two (2) backup copies of the software, which shall include, without limitation:

9.10.1 All source and executable code including all data configuration tables.

9.10.2 All design documentation relating to the software;

9.10.3 Any specified development tools required for maintenance of the software, including, but not limited to, editors, compilers and linkers, and

9.10.4 All licenses in favour of the Employer for their perpetual use by HRIDC for the entire life of the systems.

9.11 MONTHLY MAINTENANCE MEETING

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.

SERVICE LIFE SUPPORT

9.12.1 The Contractor shall ensure availability of full support to the Employer during the Service life of the project, for operation, maintenance, customization and upgradation of system/sub-system supplied and installed by him as part of the Contract. Wherever the equipment provided under this Contract Package are being upgraded/augmented/reconfigured, this support during service life for operation, maintenance, customization and upgradation shall be available for these equipment.

9.12.2 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 systems/subsystems. The copy of the MOU shall be submitted to the Employer as a proof of continuous support.

9.12.3 The Contractor/ OEM of the system/subsystem may 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. However, this ARC will be a separate contract and will not be part of this Contract.

9.12.4 The Contractor must **ensure** the following, but not limited to:

9.12.4.1 Availability/Establishment of repair/servicing facility in India. 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.

9.12.4.2 Availability/Establishment of Organization in India that can enter into Annual Maintenance/Repair Contract (AMC/ARC) with the Employer.

9.12.4.3 Availability/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/features with future up gradation etc.

9.12.4.4 Supply of Spares for entire Service life of the equipment.

9.12.4.5 Supply additional equipment required for replacement or expansion of the network in future.

9.12.4.6 Training of Employer's Personnel in Operation and maintenance of existing and new/modified equipment/sub-systems.

(End of Chapter-9)

CHAPTER 10- MILESTONES

10.1 General

(a) The construction of the Works includes a number of Stages. These Stages, called Milestones, which are inter-related with and essential to the completion of the Project, are to be achieved in the respective stipulated Time for Completion.

(b) Milestones are to be achieved in stipulated Time for Completion from the Commencement Date of the Works and all works to be achieved shall be constructed by midnight on the day given. Milestone shall be considered to be achieved on the date stated in the Milestone Certificate by the Engineer.

(c) If Time for Completion of a Milestone falls on a Public Holiday or non-working day, it shall be effective the next working day.

(d) Handing over means "the Contractor allowing access and temporary occupation to Interfacing Contractors for their works."

(e) Descriptions of each Milestone together with the Interface Contractors to which the Milestone relates, are given below.

(End of Chapter-10)

CHAPTER-11 WORK AREA (WITHIN ROW) ACCESS DATES

11.1 General

(a) The dates on which Work Areas (within ROW) are available to the Contractor for the commencement of the Works are defined as Work Area Access Dates (AD).

(b) The Work Area Access Dates that apply to this Contract are stated in terms of days after the Commencement Date of the Works.

(c) Where Work Areas are to be made available to the Contractor, they shall be available within the specified day. Where Work Areas are to be vacated, they shall be released not later than midnight on the specified day.

11.2 Work Area Access Schedule

The access to and possession of Works Area (within ROW) shall be made available as per Sub-Clause 2.1 of Part A Contract Data of Particular Conditions of the Contract (PCC).

(End of Chapter-11)

CHAPTER-12 TAKING OVER OF WORKS / SECTIONS

12.1 Procedures

12.1.1 Inspection/ Testing & Commissioning

(a) General

Within seven (7) days of receipt of the Contractor's written application for a Taking-Over Certificate, pursuant to Sub-Clause 10.1 of the General Conditions of Contract, the Engineer, in the company of the Contractor, will inspect the Works or Section covered by the application, as per the requirements described in this Sub-Clause. During the joint inspection, the Works or Section will be examined and relevant documentation will be reviewed. The Engineer will prepare a written list of outstanding items, if any, to be completed or corrected before issuance of the Taking-Over Certificate and a separate written list of items to be completed or corrected during the remainder of the Contract or the Defects Notification Period. The list shall include an agreed date of correction for each deficiency.

The Contractor shall also obtain written confirmation from all applicable Interfacing Contractors that all interfacing matters have been concluded.

If there are no outstanding items to be completed or corrected before the Taking Over of the Works or a Section, the Contractor shall submit to the Engineer all guarantees, warranties, final certifications or similar documents or both as are required under the Contract.

(b) Inspection/ Testing & Commissioning

The inspection listed in the following table shall be conducted by the Engineer, in coordination with Interfacing Contractors as necessary.

The Contractor shall prepare and submit for review and approval by the Engineer a Inspection and Testing Plan detailing and explaining how the Contractor will plan, perform and document all tests and inspections that shall be conducted to verify and validate the Works. The Inspection and Testing Plan shall consist of a narrative description supported by graphics, diagrams and tabulations as required.

Sub System/Equipment	Inspection/Testing & Commissioning
Cable	Laying
	Cable Route marker
	Cable joints
Point Machines	Testing
Track circuits	Testing
Signals	Testing
EI	Simulation testing
	Selection table testing
	VDU testing

After Inspection/ Testing of the Works as mentioned above the Contractor shall submit the Inspection/ T&C Report in the agreed format in six (6) signed copies to the Engineer for review and approval.

12.1.2 Remedial Action and Re-inspection

Within twenty-eight (28) days of receipt of a written application for a Taking-Over Certificate, the Engineer shall proceed in accordance with Sub-Clause 10.1 of the General Conditions of Contract.

12.1.3 Taking Over Certificate

If the Engineer does not issue a Taking-Over Certificate, but gives instructions in accordance with sub-paragraph (ii) of Sub-Clause 10.1 of the General Conditions of Contract, the Contractor shall, when he considers the work specified by the Engineer completed, give written notice to the Engineer and the Contractor and Engineer shall again follow the procedure in sub-clause 1.1 of this Sub-Division.

12.1.4 The Contractor shall submit documents required by Commissioner of Railway Safety (CRS) and shall accompany him during his inspection along with necessary records.

(End of Chapter-12)

CHAPTER-13 DEFECTS NOTIFICATION PERIOD

13.1 General

i. The Contractor shall be responsible for the rectification of any defect, fault or failure in the Works that is attributable to the Contractor, as may be notified by (or on behalf of) the Employeron or before the expiry date of the Defects Notification Period for the Works or Section (as thecase may be).

ii. The Contractor shall carry out the rectification of any defect, fault or failure in the Works that is attributable to the Contractor in accordance with the Defects Management Plan specified in [Defects Management Plan] in [Works Management Planning] of the General Specifications and which has received the consent of the Engineer.

13.2 Final Inspection

i. Subject to having completed the works described below and all outstanding Works, noearlier than thirty (30) days prior to the expiry of the Defects Notification Period for the Worksor Section (as the case may be), the Contractor may request the Employer and the Engineer to conduct a final inspection of the Works or Section.

ii. The Employer, the Engineer and the Contractor will conduct a joint final inspection of the Works or Section (as the case may be). The final inspection will include Contractor clean-up and Site restoration requirements. The final inspection will be completed within twenty one days from the Engineer's receipt of the Contractor's request for final inspection.

iii. During the joint final inspection, the Employer and the Engineer will identify a list of any deficiencies and agree with the Contractor a programme for the rectification of each of any suchdeficiencies.

iv. The Contractor shall correct every deficiency before the Engineer issues a Defects Correction Certificate for the Works or Section (as the case may be). After correction of any deficiencies identified during the joint final inspection, the Contractor shall request re-inspection by the Employer and the Engineer. The Employer and the Engineer shall re-inspect the Works or Section within seven (7) days from the Engineer's receipt of the Contractor's request for re- inspection.

v. The Contractor shall complete the following works prior to final inspection. In completing these works, the Contractor shall if necessary co-operate and co-ordinate with any Interfacing Contractors or Interfacing Parties and shall not interfere in their works.

(a) works to be completed prior to the final inspection of any Section

(i) any outstanding works or defects listed on the Taking-Over Certificate for the Section;

(ii) all Contractor's documentation required under the Contract has been submitted;

(iii) all interface work requirements have been completed, including but not limited to,

utilities, drainage and services;

(iv) touch-up, repair and remedy of any cosmetic deficiencies in the Works.

(b) works required to be completed prior to the final inspection of the last Section

(i) the items listed in Sub-Clause 2.5 (1) above;

(ii) restoration of the Site as follows:

- removal of all Temporary Works;
- removal/restoring of all temporary facilities, including but not limited to temporary access roads, work areas, yards, stores, toilets, offices, workshops;except as may be specified in the Contract or ordered by the Employer to remain;
- reinstatement of all topsoil and restoration of ground surfaces (to their originalcondition, if applicable; or as specified);
- removal of any remaining surplus Plant and Materials;
- removal of all debris, waste, garbage, etc. whether hazardous or otherwise and disposal of same in accordance with the Contract;
- cleaning of all drains and waterways of construction debris, waste, garbage, etc.

(iii) Plant is in good repair and good working condition and all requisite operation and maintenance manuals have been provided to the Employer.

(iv) Any operation, test or other certificate(s) or the like, not previously provided, have been provided to the Employer enabling full and unrestricted use of the Works.

(v) Ownership of or rights to/in any documentation as specified in the Contract hasbeen transferred to the Employer.

(End of Chapter-13)

Section 5: Works' Requirements

5 – II: Particular Specifications (Signalling)

TABLE OF CONTENTS

CHAPTER 1: SCOPE OF WORKS

INTRODUCTION

1.1.1 The Contractor shall consider the Project Objectives and Scope of works contained in Chapter-1 and then using the guidance given in the document, develop an appropriate Signalling system that meets the System requirements for design, implementation and support contained in enclosed Chapters.

SIGNALLING OVERVIEW

1.1.2 The work for modification at Patli station requires modification in Distributed Electronic interlocking and Absolute Block system of working with BPAC. The Single line line tracks connecting HORC Junction stations Manesar and New Patli shall be provided with Absolute block system with BPAC. Interfacing with HORC stations Signalling system shall be Bidder's responsibility.

1.1.3 Shifting of utility for carrying out Signalling/Telecom works covered in this Package for connection between proposed station of HORC and existing IR station shall be in the scope of the contractor. Such 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. The 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 with reference to schedule-C.

1.1.4 The Signals, Points, Track-vacancy detection systems and other Signalling equipment at the stations and in the Block sections will be controlled/ monitored by Distributed Electronic Interlocking (EI) located at stations. The Electronic Interlocking architecture including their size, numbers and locations shall be determined by the contractor's design. The Specification for OFC System required for communication between the various EI's is being provided under PS (Telecommunications). The OFC System required for communication between central EI and Object controllers is in Signalling scope.

1.1.5 It is a requirement that DC Track circuit technology is used to provide train detection function at the Patli station of IR. The Track vacancy detection system architecture including size, numbers and locations shall be determined by the contractor's design.

1.1.6 The Existing Power supply system for the Signaling system at the Station shall be modified to accommodated the proposed signalling power requirements. The Power supply scheme including rating, quantity and locations of Power supply systems, shall be determined by the contractor's design.

1.1.7 While the Traffic controllers at Section control centre (SCC) at New Delhi will manage overall train operations, the Railway control at local level will be managed by Station Masters located at the stations along the route. Station Masters will require an appropriate display and sufficient control to support their activity under both normal and abnormal railway operations. The Station Masters will receive/ depart trains management through information/ instructions from the Traffic Controller located at the SCC.

SCOPE OF WORKS

Broad scope of work at IR Patli shall be as per Tentative Signalling plan attached at **Appendix-9** : This broad scope provides for indicative/ approximate quantity of signalling work involved at Patli station for modification in the yard. The details quantity and work involved as per signalling plan and details given in the

PS/Signalling in order to meet the Employer's comprehensive requirements shall be contractor's responsibility. However brief scope of work covered is given below:

1.3.1 Pre-installation and testing of points in new line section, not interfering with the existing running yard.
1.3.2 Pre-installation and testing of points to be inserted in the existing running yard outside.
1.3.3 Insertion & installation of pre-prepared points as above in running lines under traffic block.
1.3.4 RE-aligning DC track circuits incorporating yard layout and shifting/ installing junction boxes, tail cables etc.
1.3.5 Installing & testing DC track circuits in new track
1.3.6 Installing signals at new location
1.3.7 Removing existing signals as required
1.3.8 Planning of signalling & telecommunication cables.
1.3.9 Laying of S&T cables and testing in new/ existing location boxes & equipment/ cable room etc.
1.3.10 Modification in power/IPS room
1.3.11 Modification in existing Siemens Distributed EI
1.3.12 End to end testing & commissioning of EI & None interlocking works.
1.3.13 Alteration/ modifications to existing DC track circuit for track vacancy detection System,
1.3.14 Alteration/ modifications to existing RDPM/ Data logger system for remote monitoring management.
1.3.15 Design, Supply, Installation, Testing, and Commissioning of Absolute Block system of working with Block proving with Axle counter (BPAC) on
a) Single line connecting Manesar (HORC) & Patli station (NR) and
b) New Patli (HORC) & Patli station (NR) section.
1.3.16 Connecting Patli-Manesar-MSL yard line through Key Lock point (KLCR) and manual operation or phase work if required.
1.3.17 Defect liability of the aforesaid Signalling system for One year period after commissioning.
1.3.18 Maintenance of the aforesaid Signalling & Telecomunication system for one year period after taking over.
1.3.19 Shifting of Chartered Signalling Utilities at existing station Patli of IR as given in Appendix-7 (List of dismantling S&T gears) in connection with proposed S&T work.
1.3.20 Shifting of existing Unchartered Signalling Utilities at existing station Patli of IR in connection with proposed Signalling work prior to the Signalling & Telecommunication work to be executed by the "PATLI/S&T" contractor as per attached tentative signalling plan.

RELEVANT DOCUMENTS

1.1.1 This Particular Specification (PS) shall be read in conjunction with the Conditions of Contract, the General Specifications (S&T) called as GS(S&T) and any other document forming part of the Contract.

1.1.2 In the event of a conflict between this document and others, the following precedence shall apply:

(1) Employer's Requirements - Particular Specification (Signalling)

(2) Employer's Requirements-GS (S&T)

(3) General and Subsidiary Rules (G & SR) of NR

(4) Indian Standards referenced herein including Indian Railway signaling engineering manual (IRSEM) with latest amendment.

(5) International Standards referenced herein.

(6) Other National Standards.

(7) Other International Standards.

1.1.3 Notwithstanding the precedence specified above, the Contractor shall seek clarification from the Engineer in the event of conflict among above specifications.

(End of Chapter-1)

CHAPTER 2: SYSTEM REQUIREMENTS

2.1 INTRODUCTION

2.1.1. The Design life of Signalling sub system/ equipment shall be as under:

S.No.	Signalling sub system/ equipment	Design life (Years)
1	Signalling Cables	25
2	Other Signalling sub system/ equipment	15
3	Low maintenance/ VRLA Batteries	7

Service life shall be counted from **the commencement date of the Defects Liability Period**.

2.1.2. For reasons of operational availability, a distributed control capability is required with an interlocking used within each station area of control to ensure points and signals do not conflict and that the train is protected from points movement during its passage.

2.1.3. The System shall be designed in such a manner that the failure of a single item of Signalling equipment shall not cause loss of overall system functionality. The use of redundancy, hot standby and cold standby shall be considered in accordance with meeting the system objectives.

2.1.4. The System shall remain fully functional with no degradation across the range of published climatic conditions found in the region. The Climatic conditions are covered under GS (S&T) of this bidding document.

2.1.5. The System shall be designed to be repaired without loss of overall functionality.

2.1.6. The System shall be designed to operate correctly and safely within a 25 KV AC Traction system environment and shall present no safety hazards to personnel working on the system.

2.1.7. The System design shall be modular and amenable to assembly and testing away from the final installation site.

2.1.8. The System shall be designed keeping energy usage as a key feature of design philosophy and making it part of the review of the system design.

2.1.9. The System shall be designed and installed in such a manner that theft and vandalism are discouraged. Track side units shall feature locks and similar deterrent features preventing plug coupled cables and modules from being removed and larger structures shall feature anti vandalism measures to the satisfaction of the Engineer.

2.1.10. The System shall be designed to interface with Signalling systems on adjacent sections of HORC and Signalling systems of connected IR stations.

2.2 SIGNALLING SYSTEM REQUIREMENTS

2.2.1 General

2.2.1.1 Absolute Block working system with BPAC on single line connection between HORC and IR station shall be provided using Block proving by Axle Counter using UFSBI with block panel as per IRS spec. described in chapter-4 with latest amendment or Solid State Block proving by Axle Counter. Wherever provision of Absolute Block working system with BPAC as described above is not feasible/ workable provision of Slot working with all necessary safety features and counters be considered.

2.2.1.2 Station area shall be designed for maximum flexibility and shall be fully signalled in accordance with current IR practices.

2.2.1.3 Interlocking of Stations and Block sections shall be provided using Distributed Electronic Interlocking.

2.2.1.4 Track Vacancy Detection System shall use DC Track circuits.

2.2.1.5 Remote diagnostic and preventive maintenance system/ Datalogger system shall be provided.

(End of Chapter-2)

CHAPTER 3: PERFORMANCE REQUIREMENTS

3.1 SYSTEM PERFORMANCE

3.1.1 The Signalling system shall be designed as per provisions of the Employer's requirements, for existing speed potential at Patli station, keeping 10% safety margins.

3.1.2 The Contractor shall carry out to the satisfaction of the Engineer, the Simulation and other Performance tests to demonstrate the System Safety and Operational performance.

3.1.3 The Reliability, Availability, Maintainability, Safety (RAMS) activities during the apportionment of system requirements, design and implementation, manufacture, integration, system validation, system acceptance and operation and maintenance during defect liability phases shall meet or exceed the requirements of CENELEC standards EN50126, EN50128 and EN50129 with latest amendments. The system phase related tasks to be carried out by the Contractor for these phases are highlighted as under.

3.2 RELIABILITY, AVAILABILITY, MAINTAINABILITY (RAM)

3.2.1 The Signalling system shall achieve all RAM requirements specified in GS (S&T) and this Particular Specifications.

3.2.2 The Employer attaches great importance to the attainment of the highest possible reliability during service of all the equipment and systems supplied and installed under this contract. The design, manufacture, installation and commissioning of the equipment and also the training of the operating and maintenance staff shall be such as to ensure near Zero Failure performance in the initial stages and that the few defects and deficiencies that may be exposed during the Service Trial are totally eliminated.

3.2.3 All the sub-systems and equipment to be used for this system shall be of proven design, in use on other similar railway projects and reliability in accordance with RAMS standards.

3.2.4 The sub-systems and equipment shall be engineered to maximize system availability during traffic hours in accordance with RAMS standards, to minimize the amount of maintenance required and to ensure that any maintenance can be easily and quickly carried out in minimum time.

3.2.5 Fault Tolerance & Graceful Degradation: The system shall be designed such that service can be maintained in the presence of faults. Subsystems and components whose failure can significantly impact on RAM performance shall be backed up by simpler sub-systems or components that permit continuous operation.

3.2.6 Recovery: Provision shall be made to recover from any credible fault while minimizing disruption to service.

3.2.7 Condition Monitoring & Diagnostics: Diagnostic systems shall be used to detect, or where practicable, anticipate faults. Such systems shall be used to reduce requirements for preventive inspection and maintenance, to reduce overall costs, and improve reliability.

3.2.8 The Contractor shall submit system Reliability, Availability and Maintainability (RAM) Plan for review and approval of the Engineer.

3.3 RELIABILITY MODELLING

3.3.1 The Contractor shall perform Reliability and Maintainability analysis of each system, up to the point of interface with other systems.

3.3.2 The Contractor shall develop an evolving Reliability model consisting of Reliability Block

Diagrams (RBD) and probability of success equations. This model shall show the relationships required for system and equipment to operate successfully. The RBD shall include multiple Electronic Interlocking and Track Vacancy Detection Systems that will be implemented for this project. The RBD shall also 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 RBD model to keep current with design iterations.

3.3.3 The reliability model consisting of reliability block diagrams and probability of success equations shall be developed and submitted to the Engineer for acceptance.

3.3.4 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.

3.3.5 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.

3.4 FAILURE DEFINITIONS

3.4.1 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.

3.4.2 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:

3.4.3 A fault in an equipment or sub-system while operating within its design and environmental specification limits;

3.4.4 Improper operation, maintenance, or testing of the item as a result of the Contractor supplied documentation.

3.4.5 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 Engineer these are attributable to Signalling System.

3.4.6 Non-relevant Failure: Any failure of an item not included in the definition of relevant failure, such as the following:

3.4.6.1 A failure caused by malfunction of other equipment or sub-system that are not supplied by the Contractor.

3.4.6.2 A failure caused by human error, except as noted in Relevant Failure above;

3.4.6.3 A failure caused by accidents not associated with the normal operation of the item.

3.4.6.4 A failure caused by operating the equipment or sub-system outside of design or environmental specification limits.

3.4.7 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:

(1) Delay to train service;

(2) Fault preventing a train from entering service at its scheduled time.

3.4.8 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.

3.5 RELIABILITY REQUIREMENTS

3.5.1 Reliability requirements and goals shall be developed in terms of Mean Time Between Service Affecting Failures (MTBSAF)/Mean Time Between Failure (MTBF).

3.5.2 The reliability requirement is subsidiary to the Availability and Maintainability requirements as specified in this PS. If higher figures are required to achieve the Availability requirements then these higher figures shall become the reliability requirements for Signalling system.

3.5.3 The Signalling System shall be fault tolerant such that if failure of any sub-system is likely to adversely affect the train operation, the reliability shall be enhanced by providing redundancy in the system.

3.5.4 Redundant sub-system shall change over seamlessly when active system fails. If changeover has a finite time, contractor shall show that its system shall not obstruct the train operation.

3.5.5 The System shall be designed to generally recover from power supply disturbances without manual intervention. The failed axle counter track sections would require resetting as per relevant Para of this specification.

3.5.6 The Contractor shall minimize the risk of common mode faults in design of the subsystems providing redundancy.

3.5.7 The MTBF/ MTBSAF of Interlocking, Track vacancy detection system, Power supply, other Signalling sub-systems (including RDPM) shall be at least, as specified in the relevant RDSO specifications. Wherever failure of any sub-system/ equipment is likely to adversely affect the train operation and Availability, the reliability shall be enhanced by providing redundancy in the system.

3.6 AVAILABILITY

3.6.1 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 Signalling System are fully achieved.

3.6.2 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 (barring Non relevant failures, as per Para 3.4 above) 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.

3.6.3 Equipment duplication, hot-standby protection, parallel-run, path diversity, etc. shall be adopted whenever necessary and appropriate to meet the required availability.

3.6.4 Signalling System shall have Availability better than the targets specified here below:

System/Sub-System	Availability	Remarks
Electronic Interlocking System (including power supply, wiring, etc.)	99.98%	Availability per system
HASSDAC, IPS, RDPM/ Datalogger etc.	99.99%	Availability per system

3.6.5 Degraded performance or loss of any software or hardware dependent function of any end equipment shall be taken as unavailability.

3.7 PERTURBATION ANALYSIS

3.7.1 A detailed system perturbation analysis shall be performed stating the types of failures that could cause service interruptions and the failure management actions required to mitigate the effect of these failures.

3.7.2 The service interruption analysis shall document all failure modes capable of causing service interruptions.

3.7.3 The Contractor shall design the system to reduce the perturbations to the minimum. Operational actions, System design features or maintenance strategies that can reduce the impact of potential service interruptions shall be submitted to the Engineer for review.

3.8 MAINTAINABILITY

3.8.1 Maintainability requirements and goals shall be developed in terms of Mean Time to Restore (MTTR). The required MTTR shall be achieved for the whole System.

3.8.2 The system shall be designed such that the MTTR shall be less than one hour.

3.8.3 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.

3.8.4 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.

3.8.5 The Contractor shall analyze each and every failure/ defect of components of various equipment to determine the cause of failure and to propose preventive/ corrective measures in the FMECA analysis.

3.8.6 The System shall be suitably designed to minimize the need for frequent preventive maintenance.

3.8.7 Redundancy shall be used to enable any necessary preventative maintenance to be carried out on off-line systems during Traffic Hours.

3.8.8 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.

3.8.9 As far as the technology permit, all vital plug-in modules shall permit hot swapping so as not to affect the normal or emergency operation of the system

3.8.10 The Contractor shall provide Service Life support as specified in PS (Signalling).

3.8.11 The OEM shall commit to provide lifetime support for the key equipment, including upgradation of software versions to ensure updated product.

3.9 SAFETY ENGINEERING

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. All circumstances susceptible to cause injuries or death of a person (public, operation staff, maintenance staff), and by extension all events leading to a partial or total destruction of costly equipment are considered as a risk.

3.10 SYSTEM SAFETY PLAN

The Contractor shall develop System Safety Plan in accordance with EN 50126 and submit the same for review and approval of the Engineer.

3.10.1 Safety Principle:

All equipment and sub-systems, including software, affecting safety and identified as being "vital" shall be designed according to the following principles:

3.10.1.1 Only component having a high reliability and predictable failure mode shall be used.

3.10.1.2 Components must be utilised in such a manner that ensures a restrictive, rather than a permissive condition will result from hardware, software or any part of the equipment failure.

3.10.1.3 Circuits shall be designed such that when a normally energized electric circuit is interrupted or de-energized, it will cause the controlled function to assume its most restrictive condition.

3.10.1.4 System safety equipment design shall be such that any single independent component or subsystem failure results in a restrictive condition.

3.10.1.5 Failures that are not independent, those failures which, in turn, always cause others, must be considered in combination as a single failure and must not cause a permissive condition.

3.10.1.6 The Signalling system shall fully conform to the interlocking principles as specified in the Indian Railway Signal Engineering Manual.

3.10.1.7 During consideration of precedence in the control of system hazards, the Contractor shall take actions to satisfy requirements in the following order of precedence:

a) Incorporation of fail-safe on 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.

3.10.2 Safety Requirements

3.10.2.1 The Contractor shall be fully responsible for the system safety within his domain 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.

3.10.2.2 The safety level of Electronic Interlocking (EI) realized with software shall satisfy the SIL4 or equivalent safety level.

3.10.2.3 Component failure shall be self-detecting by way of causing a signal to display a most restrictive aspect as far as practicable. Failure of components which are not self-detecting shall not cause any unsafe failure of the equipment.

3.10.2.4 The design of the equipment shall cater for detection and restoration of system to a safer state in case of following faults if these are likely to result in unsafe condition:

- Variation in power supply beyond its tolerance limits.
- Spikes in the power supply system.
- Insertion of PCBs in wrong card slots.
- Earthing of any component or wire or a combination of such earthing faults.
- Broken wires, damaged or dirty contacts, failure of a component to energise, loss of power supply or blown fuses etc.

3.10.2.5 During each stage in the design and development process the Contractor shall take cognizance of any hazard that arises as a result of the design or operation of the proposed equipment and takes immediate step to change the design or operation principals of the proposed equipment to mitigate the hazard.

3.10.2.6 Occurrence of any failure or error of operation in the axle counter components must not lead to any hazard but should rather transit to a safe state.

3.10.2.7 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.

3.10.2.8 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.

3.10.2.9 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 Engineer for the Management of such Residual Risk.

3.10.2.10 During the Design Review process, the Contractor shall submit analysis for Engineer's review, which demonstrate compliance with these safety principles. These analyses shall address the following issues:

(a) Circuit design;

(b) Hardware design (Failure Modes, Effect and Criticality Analysis);

(c) Electrical interference;

(d) Software errors; and

(e) System failures.

3.10.2.11 All metallic enclosures shall be provided with an earth terminal.

3.10.2.12 The design of the System shall minimise the risk of fire.

3.10.2.13 The design of the System shall minimize the build-up of static, as well as the effects of static discharge during maintenance.

3.10.2.14 Components or materials containing toxic chemicals or asbestos should not be used unless absolutely necessary and where they are to be used, they should be submitted to the Engineer for agreement.

3.10.2.15 The safety level of each function outlined in this specification shall be defined and demonstrated by the Contractor in accordance with the process defined in General Specifications.

3.10.3 Risk Acceptance Criteria

3.10.3.1 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.

3.10.3.2 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.
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.

3.10.3.3 The hazard severity is categorized into different hazard consequence levels:

Hazard Category	Consequence	Description
4	Catastrophic	Operating conditions such that personnel error environment, designdeficiencies, subsystem or componen failure or procedural deficiencies may cause death o system loss.

3	Critical	Operating conditions such that personnel error environment, designdeficiencies, subsystem or componen failure or procedural deficiencies may cause severe injury to personnel, severe occupational illness or major systen damage.
2	Marginal	Operating conditions such that personnel error environment, designdeficiencies, subsystem or componen failure or procedural deficiencies may cause minor injury to personnel, minor occupational illness or minor systen damage. Acceptable with adequate control and agreemen of the Employer.
1	Negligible	Operating conditions such that personnel error environment, designdeficiencies, subsystem or componen failure or procedural deficiencies will not result in injury t personnel, occupational illnessor damage to the system.

3.10.3.4 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

3.10.3.5 The Risk Classes are defined as follows:

Risk Class	Interpretation
Intolerable	Intolerable risk shall be eliminated
Undesirable	Undesirable risk and tolerable only if risk reduction is impracticable if the costs are grossly disproportionate tothe 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 andwith the agreement of the Railway Authority.
Negligible	Negligible Risk. Acceptable with/ without the agreement of the Railway Authority

3.10.3.6 Risk acceptance shall be based on the principles of "As Low as Reasonably Practicable" (ALARP) and as follows:

3.10.3.6.1 Category 4 hazards shall be not greater than one unsafe incident in one hundred years (1:100 years).

3.10.3.6.2 Category 3 hazards shall not be greater than one unsafe incident in one hundred years or only be accepted when the risk reduction is impractical and with the agreement of the Employer.

3.10.3.6.3 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.

3.10.3.6.4 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

3.10.4 Hazard Analysis

3.10.4.1 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 Engineer'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)

3.10.4.2 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.

3.10.4.3 The Hazard Review Procedure shall be submitted for the Engineer's approval. The final risk assessment, acceptance of mitigation and close out of hazards shall conform to the approved safety and risk acceptance criteria.

3.10.4.4 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.

3.10.4.5 The Hazard Log shall be substantially completed prior to commencement of Trial Running and shall be handed over to the Employer complete in all respects prior to the commencement of Revenue Service.

3.10.4.6 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.

3.10.4.7 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 behavior.

3.10.4.8 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.

3.10.5 Design/Systems Safety Studies and Report

3.10.5.1 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.

3.10.5.2 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.

3.10.5.3 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.

3.10.5.4The 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.

3.10.5.5Design/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.

3.10.5.6The 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.

3.10.6 Engineering Safety Validation Plan and Report

3.10.6.1 The contractor shall submit Engineering Safety Validation Plan that 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 such as

output voltage of DC-DC converter or an inverter shall not exceed pre-set value. Throughout this document details of 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.

3.10.6.2 An Engineering Safety Validation Report will be submitted after the completion of this testing.

3.10.7 Safety Case

The contractor shall submit the Safety Case which will be a documented demonstration that the product complies with the specified safety requirements. The Contractor may be required to issue updated Safety Case conforming to EN50129 after Trial Run. The Safety Case forms part of the overall documentary evidence to be submitted to the relevant safety authority in order to obtain safety approval for the system.

3.10.8 Relational Database Management System

3.10.8.1 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 aforementioned documents.

3.10.8.2 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.

3.11 RAM DEMONSTRATION

3.11.1 RAM Demonstration Plan

(1) 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.

(2) 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.

(3) The requirements relating to Reliability and Availability shall be demonstrated throughout Trial Running Period and the Defects Liability Period.

3.11.2 Failure Reporting and Corrective Action System (FRACAS)

(1) 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 Engineer.

(2) The FRACAS shall:

(a) Provide an application for reporting, classifying, analysing failures through mapping with FDPM, 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.

3.11.3 Reliability Demonstration

3.11.3.1 During the RAM demonstration phase the Contractor shall collect and maintain data on every failure of the system provided by him along with the data indicating the probable failure. MTBSAF shall be calculated throughout the monitoring period. The Contractor shall submit monthly Reliability Demonstration Reports.

3.11.3.2 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.

3.11.3.3 The Contractor shall analyze 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 Engineer.

3.11.4 Maintainability Demonstration

3.11.4.1 The Contractor shall carry out tests on all the system provided by him to demonstrate that all maintainability predictions provided are met.

3.11.4.2 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.

3.11.4.3 A minimum of 50 maintenance actions shall be included for this demonstration.

3.11.4.4 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 MTBSAF.

3.11.4.5 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.

3.11.4.6 The Contractor shall ensure that all the required information including the related Maintenance Work Instructions (MWI) etc. are available to enable him to demonstrate the maintainability targets.

3.11.5 Availability Demonstration

3.11.5.1 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.

3.11.5.2 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.

3.11.5.3 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 ensure that

(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.

3.12 ENVIRONMENT

3.12.1 Details of climatic conditions covered in this Package are given in GS.

3.12.2 The existing Signalling Equipment rooms at the stations shall be used

3.12.3 The existing Signalling Power supply Equipment room at the Station shall be used.

3.13 EMC/EMI REQUIREMENTS

3.13.1 The Signalling system provided should be electromagnetically compatible with other systems viz. Electrification, Telecommunication and Rolling Stock as per relevant national and international standards specified at Chapter-4 of this specification.

3.13.2 The Contractor shall conduct the EMI Hazard analysis at the preliminary design stage to identify sources of EMI likely to affect the Signalling system, its consequences and EMC protective measures, all of which should be detailed in the EMI Hazard analysis report. The EMI Hazard analysis report shall be submitted to the Engineer for review and acceptance.

3.13.3 EMC Control Plan

3.13.3.1 The contractor shall prepare an EMC control plan and shall submit it to Engineer for review and acceptance.

3.13.3.2 The plan shall analyse EMI/EMC impacts on the design of the Signalling System including trackside equipment as well as the general environment.

3.13.3.3 The Plan shall specify measures to increase immunity of the Signalling system.

3.13.3.4 The Plan shall include measures to reduce conducted, induced and radiated emissions to acceptable levels as specified by the relevant national and international standards.

3.13.3.5 The plan shall specify basic protective measures proposed for all electrical and electronic subsystems and components and specific measures to be adopted for the selected subsystems and components.

3.13.4 Intra system EMI

The Contractor shall ensure that any intra system EMI is mitigated through proper design and other special measures. All major subsystems shall be tested for emissions and immunities in accordance with the appropriate international standards for equipment operating in Railway or similar industrial environment as listed under Chapter-4 of this specification

3.13.5 Inter system EMI

3.13.5.1 The Contractor shall ensure that all the Signalling System is designed and manufactured in accordance with the latest issues or versions of internationally recognized EMC standards, including but not limited to EN50081, EN50082, EN50121, EN50123, IEC571, EN50155, and IEC61000 to ensure proper functioning.

3.13.5.2 The contractor shall identify all likely sources of EMI that are prevalent in the environment. Adequate measures may be taken to ensure correct operation of the Signalling system in its intended operating environment.

3.13.6 EMC Tests

3.13.6.1 The contractor shall not be required to conduct EMC tests if it can be demonstrated that the same have been done at the design stage of his equipment.However, if EMC tests were not done or if no test report is submitted, the tests have to be conducted in accordance with, but not limited to satisfying following standards for overall compliance:

(a) EN50121-1

(b) EN50121-2

(c) EN50121-4

(d) EN50121-5

3.13.6.2 In all cases where tests are not conducted, waiver for the same may be applied along with justification for approval of the Engineer.

3.13.6.3 For any standard off-the-shelf products, their EMC test certificates shall be submitted to the Engineer for review.

3.13.7 Safety related Systems Interference (Hardware/Software interfaces & protocols)

3.13.7.1 Special attention shall be given to the interference with safety related operations and equipment such as communication systems. Adequate safety margins must be ensured between the immunity levels of these safety related systems and emission levels of the Signalling and Control System specified by prevailing international standards.

3.13.7.2 If considered necessary, following measures shall be taken to improve the immunity of the Signalling system. These measures shall include, but not limited to the following actions:

(a) Proper grounding to reduce ground-loop coupling.

(b) Proper cable shielding to reduce common-mode coupling.

(c) Proper use of twisted-pair cable to reduce differential mode coupling.

(d) Proper magnetic shield to reduce low-frequency magnetic field interference from the traction system.

(e) Use steel cable supports (trunkings, trays, etc.) instead of aluminium.

(f) All cable supports shall be grounded.

(g) Correct choice of operating frequency.

(h) Use of filter to reject out-of-band noise.

(i) Proper use of surge arrestor.

(j) Use of high-level modulation technique to improve the immunity of the system.

(k) Use of redundancy codes/ checksum etc. to improve the immunity of the system.

(l) Use of parallel-check technique to improve the immunity of the Signalling system.

(m) The probabilities of various conditions which could lead to an unsafe operation shall be determined and action to resolve the same shall be taken.

(n) An appropriate technical construction file suitable for safety audit shall be submitted or if not available developed to demonstrate EMC compliance.

3.13.8 Installation mitigation guidelines for Cabling

3.13.8.1 The cables used in the Signalling system shall be adequately protected against external interference.

3.13.8.2 Additional protective measures including but not limited to the use of metallic conduit, armour, ferrite choke and EMI filters shall be used to reduce such external interference wherever required. Covered conduit is preferred.

3.13.8.3 The cables shall also be installed at a safe separation from potential interfering sources, including power cables etc.

3.13.8.4 A cable routing plan shall be designed so that there is least likelihood of coupling between the Signalling cables and the extraneous potential sources. For example, long parallel run of Signalling cable and power cable shall be avoided unless they are enclosed within separate conduits/ covered troughs.

3.13.8.5 The Contractor should refer to guidelines recommended by IEC61000-5-2, wherever possible for signal trunking/ conduit separation.

3.13.8.6 For protection against electrostatic capacitance coupling direct electrical connection between ducts of power cables and signal cables shall be avoided.

3.13.9 The latest versions of IEC-61000-5 and other relevant standards shall be complied with wherever applicable.

(End of Chapter-3)

CHAPTER 4: DESIGN REQUIREMENTS

4.1 PROJECT DESIGN STANDARDS

4.1.1 High Level Standards

4.1.1.1 The project requires contractors to work within the framework of the international standard for Quality Management ISO 9000.

4.1.1.2 Working within IEC61508, Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related System, the suppliers/contractor should demonstrate how compliance will be achieved for this project.

4.1.1.3 Where systems and products have been designed and are approved against Design standards as specified at Para 4.1.2 below, full details of approval shall be given. Where systems and products have been approved within other markets, for example against US FRA standards, then a gap analysis between the design and approving standard and the appropriate design standard specified at Para 4.1.2 below shall be required before products are approved for use on the project. The contractor will be required to give detail of how the gap analysis will be conducted.

4.1.2 Design Standards

4.1.2.1 The generic standards or other equivalent standards which are specified as under shall be applied for Signalling system.

(a) RDSO: Research, Design and Standards Organization, Ministry of Railways, India.

(b) IEC: International Electro-technical Commission.

(c) EN: European Standards Organizations CEN, CENELEC or ETSI.

(d) ISO: International Standards Organization

4.1.2.2 Research Design and Standards Organization (RDSO), an organization of the Ministry of Railways, Government of India has standardized the technical specifications for various components of railway systems in India as Indian Railway Standard (IRS) Specifications. These are generally based on International Specifications and adopted to Indian conditions. The list of IRS/RDSO Specifications issued by RDSO is available at the website of RDSO (www.rdso.gov.in). The IRS/RDSO specifications can be purchased from RDSO. The contractor shall submit the specification at the time of seeking approval of the equipment specification before procurement.

4.2 CODES AND STANDARDS

4.2.1 For the Signalling system, the following codes and standards (with latest versions and amendments) shall be followed. This list is indicative, contractor shall refer the latest approved specification.

SPECIFICATION NO.	DESCRIPTION
IRS SPECIFICATIONS	
S-6/81 along with drawings	Tubular Steel Signal Poles with Siganl base and Anchor

	bolts
S 23 - 88	Electrical and Electronic based Signalling and inter-locking equipment. Part 1: Technology & General requirements. Part 2: General requirements for Electrical Signalling & inter-locking equipment.
S 24 - 2002	Non-trailable electric point machine
S 26 - 64	Colour light signal, multi-unit type/Shunt Signal position light type
S 34 - 68	Testing Railway Signalling relays (General)
S 42 - 85	Axle counting equipment
S 63 - 2007	PVC insulated underground unscreened cables for Railway Signalling
S 66 - 84	Route indicator, direction type 5 lamp unit arm (1 to 6 way)
S71 - 87	Tag block
S 76 -89	PVC insulated indoor cables for Railway Signalling
S 93 - 96	Valve Regulated Lead Acid Stationary Battery & Charger for Railway S&T Installations
S 88-2004	Low Mainteneance battery for S&T Installation
S 101 - 90	Railway Signalling symbols
S105/2012	Block Proving by Axle Counter using UFSBI
IRS: S: 99/ 2006 Amendment 3	Datalogger system
RDSO SPECIFICATIONS	
IRS:TC 30-05	Underground railway jelly filled telecom 0.9mm quad cables for signalling & telecom installations
RDSO/SPN/TC/110/2020	RDSO Specification of 24/ 48 Fibre Armoured Optical Fibre Cable
RDSO/SPN/144/2006	Safety & Reliability requirement of Electronic Signalling Equipment

RDSO/SPN/153/2011	LED Signal lighting unit
RDSO/SPN/165/2012 Ver -3	Integrated Power supply system (IPS)
RDSO/SPN/175/2005	Solid State Block Proving by Axle Counter (Digital)
RDSO/SPN/176/2013 Ver -3	Multi Section Digital Axle Counter
RDSO/SPN/177/2012 (Ver.3)	High Availability Single Section Digital Axle Counter
RDSO/SPN/189/2004	Terminal Blocks, Fuse terminal blocks and Miniature fuse links of international standard for Railway Signalling
RDSO/SPN/192/2019 Ver 2.0	Electronic interlocking
RDSO/SPN/199/2010	LED SignalL Lamps For Main Colour Light Signals (INTEGRATED) For Railway Signalling
RDSO/SPN/197/2008	Code Practice for Earthing and Bonding system for Signalling equipment
RDSO/SPN/204/2011	Double Walled Corrugated HDPE ducts for signalling cables
RDSO/SPN/209/2012 Rev.1.0 Ver. 2.0	Fuse Auto Change Over System
BRS 941A STS/E/Relays/AC Lit LED Signal/09-2002	Universal Plug-in type, tractive armature AC Lamp proving relay (metal to carbon) for 110V AC LED SignalLamp
RDSO/SPN/217/2016 Ver. 1.0	Automatic fire detection and alarm system
RDSO/SPN/256	Earth leakage detector
RDSO/ SPN/TC/ 101/2012	Silicone Gel based Cable Jointing kit
EUROPEAN STANDARDS	
EN 50121 1,2,3,4	Railway applications - Electromagnetic compatibility
EN 50124 - 1	Railway applications - Insulation coordination - Part 1: Basic requirements - Clearances and creepage

	distances for all electronic equipment
EN 50124 - 2	Railway applications - Insulation coordination - Part 2: Over-voltages and related protection
EN 50125 - 3	Railway applications - Environmental conditions for equipment - Part 3: Equipment for signalling and communications
EN 50126	Railway applications - The specification and demonstration of Reliability, Availability, Maintainabilityand Safety (RAMS)
EN 50128	Railway applications - Communication, signalling and processing systems - Software for railway control and protection systems
IEC/EN 50129	Railway applications - Communication, signalling and processing systems - Safety related electronic systems for Signalling
IEC/EN 60529	Specification for degrees of protection from object or dust provided by enclosures (IP rating table)
EN 50123	Railway Application-Fixed installations .D.C. Switchgear. General
EN 50082 - 2	Electromagnetic compatibility. Generic immunity standard. Industrial environment.
IEC/EN 60364	Electrical installation for building.
IEC/EN 61643	Low voltage Surge protection
IEC/EN 62305	Lightning and Surge protection devices
IEC/EN 60204 - 1	Safety of machinery. Electrical equipment of machines. General requirements
IEC 61000.4.2/4.4/4.5/6.3	Electromagnetic compatibility (EMC) - Testing and measurement techniques - Electrostatic discharge , surge and immunity test and basic EMC

IEC 62278	Railway Applications- Specifications and demonstration of Reliability, Availability, Maintainability & Safety.
IEC 62279	Railway Applications-Communications, Signalling and processing systems-software for Railway Control and Protection Systems.
IEC 62425	Railway Applications-Communications, Signalling and processing systems- Safety Related Electronics Systems for Signalling.
IEC 62427	Railway Applications- Compatibility between Rolling Stock and Train Detection Systems
IEC 62280-2	Railway Applications-Communications, Signalling and processing systems - Safety related communication in open transmission systems.
IEC 62236	Railway Applications — Electromagnetic compatibility (EMC)
IEC 60571	Electronic Equipment Used on Rail Vehicles
IEC 61373	Railway Applications — Rolling stock equipment — Shock and vibration tests
IEC 62305	Protection against Lightning
IEC 61992	Railway applications — Surge arresters and low-voltage limiters for specific use in. D.C. systems
IEC 62505	Railway applications — Fixed installations — Particular requirements for A.C. switchgear
ISO/TR 16982:2002	Ergonomics of human-system interaction Usability methods supporting human-centred design
ISO 11064 Parts 1-7	Ergonomics Design of Control Centres
UL 467	Standard for safety grounding & bonding equipment
IEEE-8 and IEC 60561-7	Lightening protection system components (LPSC)-Part-7 Requirement for earthing enhancing component

4.3 MANUALS AND SCHEDULES

Following manuals and schedules shall also be referenced during the design:

- Indian Railways Signal Engineering Manual (IRSEM).

- General Rules (GR) of IR.
- Subsidiary Rules (SR) of NR
- AC Traction Manual (ACTM) of IR.
- Indian Railways Permanent Way Manual (IRPWM).
- Schedule of Dimensions (SOD) of IR.

4.4 TYPICAL INSTALLATION DRAWINGS

Following Indicative Typical arrangement drawings which are available in **Appendix -2 (Guidelines of cable laying)** of this document (NR Policy circular 02/2016 circulated vide their Letter No. 256-Sig/O/SG/Pt-XV Dated 22-08-2016) and Typical installation drawings indicated in **Appendix-6** shall also be referenced during the design :

S.No.	Description	Drawing No.
1.	Typical main cable distribution plan for Double line (4 Lines) PI sttion	SDO/CABLE LAYING/001
2.	Position of trenches for cable laying	SDO/CABLE LAYING/002
3.	Cable trench	SDO/CABLE LAYING/003
4.	Laying of Signalling Cable & Telecommunication/ Power cable in same trench	SDO/CABLE LAYING/004
5.	RCC DUCT 300 MM	NR/SIG/CABLE/001
6.	RCC DUCT 500 MM	NR/SIG/CABLE/002
7.	RCC DUCT 500 MM	NR/SIG/CABLE/003
8.	Laying of cables in Rocky area	NR/SIG/CABLE/004
9.	Track crossings	NR/SIG/CABLE/005
10.	Road crossings	NR/SIG/CABLE/006
11.	Cable laying on culverts with low flood level	SDO/CABLE LAYING/011
12.	Cable lying on culverts with high flood level	NR/SIG/CABLE/007
13.	Cable laying on metallic bridges	SDO/CABLE LAYING/013
14.	Cable trough for metallic bridges	SDO/CABLE LAYING/014

15.	Cable laying on arch bridges	NR/SIG/CABLE/008
16.	Brick masonary channel for arch bridge	SDO/CABLE LAYING/016
17.	Arrangement of jumper cable	SDO/CABLE LAYING/017
18.	CI Cable marker & concreting	SDO/CABLE LAYING/018
19.	CI Cable marker	SDO/CABLE LAYING/019
20.	Concrete cable marker	SDO/CABLE LAYING/020
21.	Method of unrolling cable	SDO/CABLE LAYING/021
22.	Rule made of pipe for measuring trench depth	SDO/CABLE LAYING/022

4.5 PRELIMINIARY DESIGN FOR SIGNALLING SYTEM

Following Preliminary design and documents for Signalling woks but not limited to shall be submitted by the contractor for approval of engineer:

4.5.1 All the drawings/arrangement for the items mentioned in Para 4.4.

4.5.2 Signalling architecture proposed at a Station as Block diagrams showing information flow from various Signalling sub system within a station, station to station and control centre to station bringing out clearly the redundancies provided.

4.5.3 Design Templates for Signal Interlocking Plan, Route Control Table/Selection table, VDU diagram, Interface circuit, Logic circuit etc.

4.5.4 Signal Interlocking Plan (SIP)

4.5.5 Equipment proposal, Sizing and Layout plan for Station

4.5.6 Typical Power Supply diagram for Station

4.5.7 Preliminary Power supply load calculation

4.5.8 Earthing, Lightning & Surge protection plan/ arrangement for Indoor Signalling equipment, Apparatus Cases, Signals, S&T Building/Hut etc.

4.5.9 Typical Signalling Cable Core plan for Station

4.5.10 Typical Cable termination details for Track side devices such as DC Track circuit/ Digital axle counters, BPAC, Points Machines, Signals, Apparatus cases etc.

4.5.11 Typical Foundation drawings for full and half apparatus cases

4.5.12 Typical Foundation drawings for Main and Shunt signals

4.5.13 Architecture lay out for RDPM system/ Datalogger

4.5.14 Bridge crossing drawing for Major, minor and all other bridges

4.5.15 Typical drawing for Road crossing, Track crossing by Signalling cables

4.5.16 Typical drawing for Laying of Signalling cable in Station limit and outside of station limit

4.5.17 Typical Installation drawing of DC Track circuits

4.5.18 Typical Installation drawing of HASSDAC

4.5.19 Typical Installation drawing of Point machines

4.6 DETAILED DESIGN FOR SIGNALLING SYSTEM

The Detailed design and documents for Signalling works at all stations shall include following but not limited to:

a) Signal Interlocking Plans
b) Route Control tables/Selection table
c) VDU Diagrams
d) System configuration showing EI connectivity, Configuration data, parameters and setting
e) Equipment Layout Plans for Signal Equipment Room, Power Supply Room, Location/Junction Boxes, S&T Huts, Battery Room etc.
f) Equipment Rack details
g) Fuse Details
h) Relay Contact Analysis
i) Interconnection details of all equipment in Signalling rooms
j) Application Logic circuits
k) Interface circuit
l) Circuit Diagrams/ Wiring diagrams
m) Power supply Load Calculation for a station as well as for Signals, Point Machines, Axle counters, BPAC and Detailed Signalling Power supply distribution arrangement at Station.
n) Cable Termination Rack Diagrams
o) Combined drawings for all RDPM/ Dataloggers equipment
p) Cable Core Allocation
q) Cable Route Plan
r) Track devices termination details
s) Cable termination details of locations/ Junction boxes
t) Earthing, Lightning & Surge protection plan/ arrangement for Indoor and outdoor Signalling equipment
u) Station Working Rule and Station working rule Diagrams
v) Drawings/ Documents for NI

4.7 GOOD FOR CONSTRUCTION DRAWINGS

The GOOD FOR CONSTRUCTION drawings for Signalling works shall include but not limited to: All drawings and documents described for Preliminary/ Detailed Design & Documents for Signalling Works.

4.8 AS-BUILT DRAWINGS

AS-BUILT Drawings & Documents for Signalling works shall include but not limited to:

- All drawings and documents described for GOOD FOR CONSTRUCTION of Signalling Works.
- Official letters regarding the design change acceptance;

- Certificates of acceptance between the Contractor and the Engineer;
- Design Certificate.
- Station Working Rule and Station working rule Diagrams.
- Document and drawings for NI
- Operational Safety case
- CRS sanction supporting documents
- Operation & Maintenance manuals for whole Signalling system/ subsystems

4.9 PROCUREMENT

- The contractor may procure items/ equipment either locally (from India) or from the international market.
- RDSO maintains an approved list of suppliers/ vendors for various equipment/items/ components to be used on railway systems in India. The list of suppliers/vendors approved for various items are available at the website of RDSO (www.rdso.gov.in).
- The list of applicable RDSO specifications is given in Para 4.1.2 of this document. If procured locally items shall be procured from RDSO's "Approved list of firms for manufacture and supply" and as per relevant specification. Before procurement MODEL & VENDOR NAME of equipment shall be submitted by the contractor to the engineer for approval.

(End of Chapter-4)

CHAPTER 5: SIGNALS

5.1 SYSTEM REQUIREMENTS

5.1.1 All Signals and Subsidiary signals should be designed and implemented in accordance with Indian railways General rules and Signal engineering Manual and other requirements of this specification.

5.1.2 The design of the proposed Absolute Block working system with BPAC shall, as far as possible avoid positioning of signals at following locations, where they can display a red 'STOP' aspect:

- Where trains may stop across a junction or a point of conflict with another train;
- Where trains may stop inside or too close to an OHE Neutral Section;
- Where trains may stop at steep up/down gradient.
- Where trains may stop in a position that is considered dangerous.

5.1.3 All Main line signals shall be 2/3/4 aspect Colour light line side signals. The signals on the loop lines shall be 2/3 aspect signals.

5.1.4 Position light type Shunt signals shall be provided below Starter and Intermediate Starter signals.

5.1.5 Independent Position light type Shunt signals shall be provided for exit from sidings and shunt back from Advanced Starter. Sufficient number of such Shunt signals shall be provided so as to allow maximum flexibility in shunting movements in the yard.

5.1.6 Calling-ON signal shall be provided below all Home signals and Starter/ Intermediate Starter signals if required.

5.1.7 The Main Signals leading to more than one route shall be provided with Junction type/ Theatre Route indicators.

5.2 TECHNICAL REQUIREMENTS

5.2.1 The Colour light tubular signal posts, outside dia. 140mm, length 3.5/4.5/5.5 meters or more (as per requirement) complete with surface base, anchor bolts, ladder with platform guard rail etc. shall be provided as per IRS spec described in Chapter-4 with latest amendment and relevant RDSO drawings.

5.2.2 The Main running signals shall be Multi unit Colour Light Signals as per IRS spec. described in Chapter-4 with latest amendment and relevant RDSO drawings.

5.2.3 All signals, main or subsidiary shall use LED Signal lighting unit as per RDSO specification described in Chapter-4 with latest amendment. LED Signal Lighting Unit shall work on 110V 50 Hz AC. ECRs as per RDSO specification described in Chapter-4 with latest amendment shall be used with LED Signal Lighting Units.

5.2.4 Directions type (Junction Type) route Indicators (5 lamp unit arm) using LED signal light, complete with all the fittings shall be supplied as per IRS specification described in Chapter-4 with latest amendment and relevant RDSO drawings.

5.3 INSTALLATION OF SIGNALS

5.3.1 Signals shall be installed clear of the structure gauge as per the provisions of IRSEM and SOD of IR.

5.3.2 The signal shall be so located that a clear view is available to the driver of an approaching train and it shall be as close to the track as permissible. The actual visibility of signal shall be checked by a Signal sighting committee and action to improve the visibility as per recommendation of the committee shall be taken before commissioning any new signal. The Signal sighting committee shall be nominated by the Engineer.

5.3.3 Location of signals shall be worked out as per the requirement of IRSEM, 25 KV AC traction system of IR. The signal shall be located beyond electrical clearances. Suitable metallic protective screening shall be provided if electrical clearance are not achieved.

5.3.4 All mountings on Signal post viz. Shunt signal, 'Calling ON' signals shall be done using separate brackets of suitable size for each of them.

5.3.5 Signals/ route indicators on posts shall be equipped with a ladder & maintenance platform enabling access to the LED Signal Lighting Units as well as Shunt signal, Calling 'ON' signal mounted on the post.

5.3.6 Suitable Earthing arrangements shall be provided for all signals.

5.4 FOUNDATIONS FOR SIGNALS/ APPARATUS CAES

5.4.1 The foundations of signals/ apparatus cases must be made of concrete.

5.4.2 The foundations must be dimensioned sufficiently for signals on posts, shunt signals and apparatus cases.

5.4.3 The height of the foundations must be adjusted to the geographical situation (slope etc.) and to the location of the signals. It should not be more than rail level. Depth of foundation for main signals from ground level shall not be less than 1.3m.

5.4.4 The height of independent Position Light Shunt signal shall not exceed a maximum limit that may infringe the SOD of IR. Depth of foundation from ground level shall not be less than 600mm.

5.4.5 The foundation drawings of Main signal, Position Light Shunt Signals (Independent) and Apparatus cases shall be proposed by the Contractor and approved by the Engineer.

5.4.6 Suitable pre-fabricated assembly units of reinforced concrete may be used with the approval of the Engineer. In this case the foundation must have one or several eyebolts for transport purposes. These must be closed after final mounting.

5.4.7 All Signals/ Apparatus cases foundations shall have SOD clearance from the track.

(End of Chapter-5)

CHAPTER-6: DISTRIBUTED INTERLOCKING

6.1 GENERAL

The principles of interlocking as per IRSEM shall be followed while designing the Signalling system.

6.2 SYSTEM REQUIREMENTS

6.2.1 Each Station control area including adjacent Block sections shall have a high integrity Distributed Electronic interlocking suited to work with a dual Hot standby VDU Control terminals for Signalling control. However, existing VDU Control terminals may be used.

6.2.2 The Electronic Interlocking shall be housed in existing Signal Equipment Rooms (SER) at the stations and existing Object Controllers in the S&T Huts. The number of Electronic Interlocking and their locations shall be determined by the Contractor's design.

6.2.3 Wherever interlocking equipment (Central Interlocking Unit or Object Controller) is located, a display shall be available showing the state of the railway under control by that interlocking and up to the neighboring control area on both sides. The display shall be provided in all the Station master Rooms at Stations.

6.2.4 The interlocking shall be provided with a data recording system allowing all interlocking states to be time stamped and recorded. The data recording system shall record and retain interlocking state data for a minimum period of 7 days on a rolling 7 day basis. Interlocking data shall be available to the user for interrogation through a suitable PC interface.

6.3 TECHNICAL REQUIREMENTS

6.3.1 The Electronic Interlocking (EI) shall be as per RDSO specification described in Chapter-4 with latest amendment.

6.3.1 Separate I/O Cards shall be used for UP & DN lines for improved functionality.

6.3.2 The System design shall ensure that required integrity of safety related vital information is maintained during communication between EI and EI/ Object Controllers. In this regard, the requirements for transmission of vital safety information, as laid down in RDSO specification and EN specification described in Chapter-4 with latest amendment shall be followed.

6.3.3 The EI Processor shall have sufficient capacity to handle without any degradation, the load of additional I/O when added in future utilising available spare provisions as indicated at relevant Para

6.3.4 Interlocking input and output circuits and associated interface cabling shall be suitable for use within 25 KV AC traction system environment and shall be suitably protected against transient and high voltage discharge interference.

6.3.5 All the Electronic Interlockings shall be connected through duplicated self- healing fail safe OFC rings for transfer of Vital data among EI systems. The connection shall be such that full network protection against single fibre failure is available with seamless switchover between the redundant OFC's. The contractor shall make maximum use of shared backbone communication links for diagnostic and operational information transfer. Connection between Central unit and Object Controllers of EI shall also be separate dual OFC ring.

6.3.6 At connecting station namely Patli of IR presently EI of **Siemens make** has been provided. And necessary Signal equipment EI, DC Track circuits, BPAC, Block instrument etc. required as per the scope of work shall be provided in existing Signal equipment/ Relay room. If space is not available in the existing rooms separate Rooms shall be provided by

the Civil contractor.

6.4 INTERLOCKING DESIGN

6.4.1 The Tentative Signal interlocking plan (SIP) has been in Appendix-9. This shall be reviewed and revalidated by the contractor from Signalling & Interlocking point of view.

6.4.1 Based on the approved ESP (Engineering Scale Plan) the contractor shall prepare the Signal Interlocking plans (SIP), the Control Tables, the HMI drawing and other documents for the Stations. The SIP, Control Tables, the HMI drawing and other documents shall be prepared in accordance with interlocking principles provided for in the IRSEM.

6.4.2 Approval from Indian Railway for SIP and other Signalling documents required for modification of S&T system at Patli station shall be taken by the contractor. Before submission of these documents to railway its approval from the Engineer is required.

6.4.3 The approved SIP, Tables of Control, the HMI and other documents shall form the basis for the design of Signalling system.

6.4.4 The interlocking including object controllers shall be designed with a Hot standby capability as per RDSO specifications of EI.

6.4.5 EI system shall ensure the compliance of provisions of IRSEM, including the following:

- Route Locking after Route setting;
- Route holding when train passes through the route set;
- Approach locking after route cancellation when train approached the set route; and
- On all legitimate routes the conditions and the signal aspects shall be laid down in the Interlocking Table/ chart.
- The System shall have provision for accommodating additional 20% of the I/O used as minimum spare provision, including corresponding Processor capacity for future use.

(End of Chapter-6)

CHAPTER-7: VDU CONTROL SYSTEM

7.1 SYSTEM REQUIREMENTS

7.1.1 Existing VDU control system and Maintenance Terminal at Patli station shall be used.

(End of Chapter-7)

CHAPTER- 8: BLOCK PROVING AXLE COUNTER

8.1 TECHNICAL REQUIREMENTS

Some of the important features of the Block proving Axle counter (BPAC) system to be provided shall be as follows but not limited to :

8.1.1 The Block sections shall be provided with High Availability Single Section Digital Axle Counter as per approved RDSO specification described in Chapter-4 with latest amendment. Block proving by Axle Counter using UFSBI with Block panel as per IRS Specification described in Chapter-4 with latest amendment or using Solid State Block proving by Axle Counter shall be provided. UFSBI/ Solid state block panel as per approved RDSO/IRS spec. described in Chapter-4 with latest amendment Block working through EI system shall comprise of Block Panel, Universal Fail Safe Block Interface, HASSDAC, Block Telephone, Relays etc.

8.1.2 The BPAC shall work on Optical Fibre Cable System and Quad cable with Auto Change Over arrangements.

8.1.3 Power Supply requirement shall be met from IPS to be provided by the Contractor for Signalling systems.

8.1.4 It shall not be possible to take the Last Stop Signal (i.e. Advance Starter) to "OFF" unless "LINE CLEAR" has been obtained from station in Advance.

8.1.5 It shall not be possible to obtain "LINE CLEAR" unless Block section and Adequate Distance beyond the First Stop Signal (i.e. Home Signal) of station in Advance is clear of trains.

8.1.6 The Last Stop Signal (i.e. Advance Starter) shall assume "ON" aspect automatically on entry of train into block section and when so replaced shall maintain its "ON" position till a fresh "LINE CLEAR" is obtained on Block Panel/ VDU.

8.1.7 Block section shall automatically show "TRAIN ON LINE" on panel when train enters into Block section on Line Clear.

8.1.8 Train Entry/ Exit buzzer To/ From Block section shall be provided which shall be acknowledged by the concerned ASM.

8.1.9 Block section shall automatically close on complete arrival of Train at receiving station.

8.1.10 A Control mechanism shall be provided to prevent the station in rear to take "LINE CLEAR" on its Block Panel/ VDU without taking consent of receiving station.

8.1.11 A Control mechanism shall be provided to "CANCEL" the "LINE CLEAR", already taken by station in rear.

8.1.12 It shall be possible to close the Block section only if no train has entered the Block section for at least 120 seconds after application of Line Clear Cancellation with cooperation of station in rear.

8.1.13 Separate Block Telephones shall be provided for every Block section.

8.1.14 Separate Evaluator shall be provided for UP and DN lines.

(End of Chapter-8)

CHAPTER-9:TRACK VACANCY DETECTION SYSTEM

9.1 SYSTEM RQUIREMENTS

9.1.1 Track-vacancy detection shall be continuous, shall be provided at the Stations, shall be on all the lines including berthing portions of sidings at the stations.

9.1.2 DC track circuits and associated equipment/ arrangement shall be used for track vacancy detection compatible with existing system at IR station Patli .

9.1.3 The tolerance of detection accuracy for detecting the position of the vehicle/ train shall be such that safety is maintained, operational requirements are fulfilled and fouling marks are not infringed, under worst-case conditions.

9.1.4 The contractor should comprehensively detail the impact of system failure on train detection and the impact on train detection once the failure is restored.

(End of Chapter-9)

CHAPTER-10: POINTS AND POINT MACHINES

10.1 SYSTEM REQUIREMENTS

10.1.1 At Patli station, turnouts and derailing switches are programmed to be used.

10.1.2 The new Points laid in the station yard of Patli by the Track contractor under shall meet all the requirements set out in the IR Signal Engineering Manual for which the Signalling contractor shall interface with the Track contractor.

10.1.3 The indicative list of items for which the contractor shall be required to maintain Interface with the Track contractor is given in interface management in Appendix 10 (Interface management).

10.1.4 All the points shall be worked with High thrust/ Normal Electric Point machines as the case may be.

10.1.5 It shall be possible to operate trains through all points and crossings in all directions of travel. Loss of electrical power shall not cause a change of physical point status and the points shall remain locked in the last operated position.

10.1.6 The Point machines and the ground connections supplied by the S&T Contractor shall be compatible with turnouts and derailing switches provided by the Track contractor. The contractor shall interface with the Track contractor for the same.

10.1.7 Point machines supplied shall be simple in operation and shall require minimum maintenance. They shall be small compact units, readily accessible and interchangeable.

10.2 TECHNICAL REQUIREMENTS

10.2.1 Non Trailable Electric Point machines shall be as per specification described in Chapter-4 of this document with latest amendments. The Point machines with 220-mm thrust to drive Thick Web Switches and with 143-mm Thrust to drive other switches shall be provided with external Clamp locking arrangement.

10.2.2 Provision shall be made for individual manual operation of each point. Electrical Power shall get disconnected from the point drive under manual (crank handle) operation. Crank handles used for manual operation of point shall be interlocked such that removal of key for crank handle operation shall prevent setting of relevant routes. The number of keys for crank handles operation shall be minimized by suitable grouping such that the impact on operations is minimal when the key is taken out.

10.2.3 Point detection shall be provided to detect that each switch is positioned with sufficient accuracy to ensure safe travel through the point before authorizing a train movement over the point. The limits of Obstruction Test shall be as per the requirement of IRSEM.

10.2.4 Where the points form a crossover independent detection shall be provided for the points at each end of the crossover. The two independent detections can however, be proved together and read into EI as a single input.

10.2.5 The relative position between the point machine and the stock rail shall be fixed such that independent movement is prevented.

10.2.6 The super imposed detection is not permitted.

10.2.7 Locking detection shall be provided to detect that the point lock is in the respective locked position before authorizing a train movement over the point.

10.2.8 Provision shall be made for emergency operation of points during track section failure.

Each such operation shall be recorded by a suitable counter.

10.2.9 All point operating equipment and point operation & detection circuits shall be totally immune from 25 KV AC Traction current effects or other EMI sources.

10.2.10 Point machine wires shall be protected to prevent short-circuiting and monitored continuously for earth leakage.

10.3 POINT MACHIEN INSTALLATION

10.3.1 Point machines installed shall present a minimum hazard to people walking along the track.

10.3.2 Point machines shall be installed beside the close switch leading to high speed movement clear of all infringements.

10.3.3 No point machines shall be installed in between the main line tracks.

10.3.4 The point machine cover shall be provided with secured locking mechanism.

10.3.5 The point machine shall be installed as per RDSO/OEM checklist.

(End of Chapter-10)

CHAPTER-11: RELAYS

11.1 SYSTEM REQUIREMENTS

11.1 The various types of relays used in interlocking systems shall comply with IRS specification no. S-34 and the requirements of IRS, BS or BRS specifications or any other specifications as approved by the Engineer.

11.2 Electronic Type Time element relays conforming to IRS/BS/BRS or of the specification approved by the Engineer shall be used. When electronic time element relays are used these shall be two in number and their contacts should be proved in series with each other.

11.3 The relays shall be preferably of the plug-in type. The contractor shall seek the advice of the Engineer in case other than plug-in-type relays are proposed to be used.

11.4 All plug-in Relays and relay groups shall be fitted with non-interchangeable interlocking device to prevent the wrong relays/ relay group being accidentally plugged in during replacements.

11.5 Removal or replacement of plug-in relays/ relay groups during operation shall not cause any unsafe conditions in the circuits.

11.6 All relays shall, to the extent possible be housed in the Signalling Equipment room.

11.7 All relays shall have minimum 10% of working contacts as spare subject to a minimum of one front and one back contact.

11.8 The use of relays within the Signalling sub system shall, however be minimised by design.

(End of Chapter-11)

CHAPTER-12: INTEGRATED POWER SUPPLY FOR SIGNALLING SYSTEM

12.1 SYSTEM REQUIREMENTS

12.1.1 The Power supply scheme for Signalling and Telecommunication System should be based on 230V 50Hz AC supply.

12.1.2 At IR station Patli, necessary power supply equipment/ battery system shall be provided in existing power supply equipment/ IPS/ Battry room. If space is not available in the existing room separate Rooms shall be provided by the Civil Contractor.

12.2 BATTERIES FOR SIGNALLING

12.2.1 All Batteries for Indoor installation like with IPS etc. shall be VRLA batteries as per IRS Specification described in Chapter-4 of this document with latest amendment.

12.2.2 All batteries for Outdoor installation like Track circuit etc. shall be Low Maintenance Batteries as per IRS Specification described in Chapter-4 with latest amendment.

(End of Chapter-12)

CHAPTER-13: DATALOGGER SYSTEM

13.1 SYSTEM REQUIREMENTS

13.1.1 Existing Datalogger system at Patli station shall be modified to accommodate the proposed signalling works at Patli station.

(End of Chapter-13)

CHAPTER-14: FUSE AUTO CHANGEOVER SYSTEM

14.1 SYSTEM REQUIREMENTS

14.1.1 On the failure of a Main fuse its standby fuse should come in circuit automatically before dropping of Signaling Relay. The Changeover time shall not be more than 20 milliseconds at rated voltage of the system.

14.1.2 RDSO specification described in Chapter-4 with latest amendment shall be followed.

14.1.3 The system shall be modular by design and each module of the system shall have capacity for monitoring either of the following:

- TYPE-I: 32 nos. of external Non-Deteriorating Type or 'G' type fuses from 0.6 Amp to 4 Amp capacities which are in Signaling circuits. System shall have 8 cards with monitoring arrangement of 4 fuses in one card.
- TYPE II: 24 no. of external Non-Deteriorating Type or 'G' type fuses from 4 A to 10 Amp capacities generally used for Point Operation circuits. Such system shall have 6 cards with monitoring of 4 fuses in one card.

14.1.4 The system shall be capable of monitoring fuses with system voltage of fuse circuit as 12V, 24V, 60V or 110V DC/AC.

14.1.5 GSM Modem: A GSM modem shall be supplied and with such modem connected the system(s) shall send SMSs on GSM network to upto 5 preselected GSM mobile numbers in case of any of the fuse blowing. The mobile numbers shall be configurable.

14.1.6 Common audio- visual alarm unit shall be hanged in ASM's room or any other convenient place and shall have following features: -

- Power supply OK - YELLOW Indication (5 mm LED).
- Common failure LED indication (RED) in case of any main fuse getting blown out at the station.
- Another LED indication (RED) if any of the standby fuse also is blown along with its Main fuse. Both the LEDs shall be lit in case of both Main and Standby getting blown.
- Piezoelectric buzzer to give audio alarm for failure conditions mentioned
- A Non locking type Push Button for acknowledgement of Audio Alarm.
- A suitable fuse shall be provided at input of the power supply inside the unit.

NOTE: 5 mm RED LED with suitable holders and flashing indications to be used.

14.2 TECHNICAL REQUIREMENTS

14.2.1 The changeover facility covered in this specification should be suitable for changing over of circuit operation from main fuse to spare fuse automatically when main fuse is blown off without affecting the functioning of signaling circuits and point machine circuits. At every change–over, audio/visual indication should appear.

14.2.2 Equipment shall work either on 24V DC, 60V DC or 110 V AC as specified by the purchaser. The equipment shall be able to work in tolerance range of +20%, - 30%. The Power supply used in the system shall be SMPS type. Reverse polarity protection and Overload protection voltage should also be provided in the power supply circuit.

14.2.3 The following components shall be provided on the Power Card Module of the system:

- POWER ON Indication (LED based).
- Buzzer ACKNOWLEDGE push button.
- Fuse for protection of Power card module.
- TEST push button for checking health of all indications.
- Buzzer

14.2.4 Following components shall be provided on each monitoring card of the system:

- Standby Fuses.
- LED indications for Main and Standby Fuses monitored by the card.
- RESET push button (one for each monitoring card)

(End of Chapter-14)

CHAPTER-15: AUTOMATIC FIRE DETECTION AND ALARM SYSTEM

DELETED

(End of Chapter-15)

CHAPTER-16: EARTH LEAKAGE DETECTOR

16.1 SYSTEM REQUIREMENTS

16.1.1 Earth leakage detection system as per RDSO specification described in Chapter-4 of this document with latest amendment shall be provided at Patli station to monitor Earth leakage/ Fault in all proposed Outdoor/ Signalling Cables and all Power Supply Bus bars used in Signalling system.

(End of Chapter-16)

CHAPTER-17: SIGNALLING CABLES

17.1 SIGNALLING OUTDOOR CABLES

The Cables for carrying outdoor Signalling circuits shall be PVC insulated, PVC sheathed and armoured unscreened cable conforming to IRS specification described in Chapter-4 with latest revision and amendment. The cable conductor shall be of annealed copper having minimum cross-sectional area of 1.5 sq. mm of 24Core, 19Core, 12 Core, and 6 Core and Power cable of 25 Sq mm multistrand.

17.2 SIGNALLING INDOOR CABLES

Indoor cable/wire used shall be single core, plain annealed high conductivity copper conductor, PVC insulated unarmoured as per IRS specification with latest amendment, tinned flexible single core indoor wire in different colours or suitable cable shall be used. All electronic equipment shall however, be wired as per the requirement of the relevant RDSO specification of the equipment and/or as specified by the OEM. The Q style Relay wiring shall be carried out with 16/ 0.2mm size flexible multicolour wire. The cable conductor for indoor power cable shall be of annealed copper having minimum cross-sectional area of 10 Sq mm.

17.3 QUAD CABLE

The Quad cable used for Axle Counter circuit shall be 6-Quad Telecom underground Jelly filled cable as per RDSO specification described in Chapter-4 of this document with latest amendment.

17.4 OPTICAL FIBRE CABLE

The Optic Fibre Cable for the Signalling system shall be provided as per RDSO specification described in Chapter-4 of this document with latest amendment.

17.5

17.5.1 Min. 10 Pair PIJF cable shall be provided from home signal to station master/ S&T room for point to multi point communication with magneto phones and Auto phone from all points, signals and location boxes.

(End of Chapter-17)

CHAPTER-18: LEVEL CROSSING GATES

DELETED

(End of Chapter -18)

CHAPTER-19: MAINTENANCE OF INFORMATION SYSTEM FOR SIGNALLING & TELECOMMUNICATION SYSTEM

DELETED

(End of Chapter-19)

CHAPTER 20: INSTALLATION REQUIREMENTS

20.1 GENERAL

20.1.1 The construction requirements establish the overall procedures for the Contractor to follow for the Works that is related to the components manufactured off-site and supplied for installation, assembling and wiring of the Permanent Works. These requirements relate to their Manufacturing, Supply and Installation in the system and associated activities. The requirement given here are specific requirements to be read in conjunction with the general requirements given in GS (S&T).

20.1.2 The requirement of Construction/ Installation Plan, Method Statement, Manufacturing/ Procurement, Delivery, Storage and Installation at site are covered in detail in GS (S&T). The requirements given here are specific requirements to be read in conjunction with the general requirements given in this GS (S&T).

20.1.3 The Contractor shall be required to demonstrate that the Construction/ Installation system Procedure, adopted would enable installation of equipment in the minimum time available commensurate with the project aims. The contractor shall identify and undertake the construction activities that are possible to be carried out **away from the site** and include them in his Construction/ Installation Plan and Programme.

20.2 INSTALLATION

20.2.1 All the important Signalling equipment viz. Distributed EI with object controllers, HASSDAC, LED Signals, IPS, RDPM/ Data Loggers, Point Machines, BPAC etc. shall be installed in accordance with RDSO and 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 adequate for satisfactory performance of the equipment. As far as possible the equipment shall be **commissioned after such a certificate** has been issued by the OEM.

20.2.2 Indoor Installation

20.2.2.1 All items of the Signalling system comprising active electrical and electronic components shall, as far as possible be located in the Signalling equipment rooms.

20.2.2.2 All wall-mounted equipment shall be installed at appropriate height to avoid any hazards to the person passing by. The Contractor shall ensure the fixture is of sufficient strength to hold the wall-mounted equipment in a secure and safe manner. Sufficient space shall be provided to allow for front maintenance access of the wall mounted equipment.

20.2.2.3 All floor mounted equipment cabinets in the equipment room shall be securely bolted to ground, properly aligned and levelled. Racks/ Cabinets shall be suitably protected against entry of rodents, lizards etc. and also from effects of vibrations generated from train movements. All cable entries shall be sealed using suitable cable sealing system. The floor mounted equipment cabinets shall be arranged in a way to allow sufficient space at the front and rear side of the cabinets for maintenance access.

20.2.2.4 The equipment layout within the equipment room shall be designed to:

- Allow sufficient clearance for escape out of the equipment rooms in case of emergency.
- Allow sufficient space at the front and at the back of the equipment for the maintainer to attend to the equipment freely without obstruction.

- Allow required space around the equipment as mandated by the OEM/ RDSO specification.

20.2.2.5 The Contractor shall submit the following to the Engineer for review at least three months before the commencement of the installation inside the equipment room:

- Drawings showing the equipment layouts and positions of the racks,cabinets and enclosures.
- Racks, cabinets, layout drawings showing the arrangement of individual module.
- Specifications, sample of all the mounting brackets and accessories.
- Equipment mounting and installation methods.
- Schematic diagrams and wiring diagrams of the System.
- Electrical distribution schematics within the room including the earthing details and
- Cable route diagrams for cables within the room.
- Installation work inside the room shall be carried only after these submissions have been reviewed without objection by the Engineer.

20.2.3 Signalling Structures

20.2.3.1 For housing the Signalling Indoor equipment existing Signalling equipment rooms shall be used.

20.2.3.2 The installation layout of SERs at Staions and S&T Huts shall be planned in such a way that number of indoor equipment units, their size and installation as per contractor's design for better utilization of space and same got approved by the Engineer.

20.2.3.3 The S&T Contractor shall coordinate with Building Contractor for construction of **Cable pit/ Duct for entry/ exit of cable**.

20.2.4 Outdoor Installation

20.2.4.1 All the ducts/ troughs/ pipes for laying cables shall be provided by the contractor.

20.2.4.2 All the mounting brackets and accessories shall be corrosion resistant, aesthetically designed to match with all architectural finishes and of sufficient strength to mount the equipment securely.

20.2.4.3 If the equipment is installed at locations exposed to direct sunlight, the equipment, mounting brackets, cables and accessories shall be made of materials which are resistant to ultra violet rays.

20.2.4.4 All trackside equipment and the mounting method shall be designed in a way to minimize frequency of preventive maintenance and theft and vandalism.

20.2.4.5 The Contractor shall submit the following to the Engineer for review at least three months before the commencement of the outdoor installation activities:

- Specifications, sample of all the mounting brackets and accessories.
- Equipment mounting and installation methods.

- Schematic diagrams and wiring diagrams of the System.

20.3 SIGNALLING CABLE LAYING, TERMINATION AND TESTING

20.3.1 Signalling Cables

20.3.1.1 The Cables for carrying **outdoor Signalling circuits** shall be PVC insulated, PVC sheathed and armoured unscreened cable conforming to IRS specification, described in chapter-4 with latest amendment. The cable conductor shall be of annealed copper having minimum cross sectional area of **1.5 sq. mm** and core of **6/12/19/24. Guidelines for cable laying** as Appendix-2 shall be followed.

20.3.1.2 The Cables for carrying **Signalling power supplies** outdoor shall be copper conductor, minimum conductor size **25 sq. mm,** PVC insulated armoured, unscreened, underground power cable as per IRS specification described in Chapter-4 of this document with latest amendment and IS: 1554 (Part-2). The size of conductor shall be so selected as to suit the Electrical load. This shall include Power cable of **suitable size if required** for extending the **Electric Power supply to Object controller rooms** from the IPS Room at station building. Separate power cable for **110V AC, 24V DC upto distant signals, 110V DC for point machines and 24V DC for BPAC** shall be provided.

20.3.1.3 The **Optic Fibre Cable** for the Signalling system shall be provided as per RDSO Specification described in Chapter-4 of this document with latest amendment. Two no. redundant cables if required with route diversity shall be provided from Central EI to Object controller. Necessary OFC equipment shall be installed for ofc communication between central EI and object controllers.

20.3.1.4 Indoor Cable/ Wire used shall be single/ multi core, plain annealed high conductivity copper conductor, PVC insulated unarmoured as per IRS specification described in Chapter-4 of this document with latest amendment. The indoor power cable for carrying **Signalling power supplies** shall be copper conductor, minimum conductor size 10 **sq. mm,** PVC insulated armoured, unscreened, underground power cable as per IRS specification described in Chapter-4 of this document with latest amendment and IS: 1554 (Part-2). All electronic equipment shall however, be wired as per the requirement of the relevant RDSO specification of the equipment and /or as specified by the OEM. The Q style relays shall be wired with 16/ 0.2 mm multistrand wire. The contractor shall take prior approval of Engineer if indoor cable/ wire other than RDSO approved are proposed to be used.

20.3.1.5 All cables shall be adequately rated for their current carrying capacity. All power cables shall be able to withstand full load current for peak operation. The Contractor shall comply with the latest edition of IEE Wiring Regulations.

20.3.1.6 A **labelling** scheme shall be applied for all cables installed. Each cable shall be uniquely identified. Labels shall be tied at both ends, at entry and exit points of cable trays, ducts and trenches and at other appropriate locations where necessary. Type of labels to be used shall be got approved from the Engineer.

20.3.1.7 The **DWC-HDPE pipe/ duct** used for protection of Signalling cables **below the track/ road, on the slope of embankment for crossing bridges, on the top of PCC/RCC bridges** or any other place shall be supplied as per RDSO specification described in Chapter-4 of this document with latest amendment.

20.3.1.8 Medium type **GI Pipe** (blue colour strip) shall be provided on the top level of all OWG

bridges.

20.3.1.9 On top of PCC/RCC bridges, if concrete cable duct is not available then GI pipe with suitable support shall be provided with concrete cover by S&T contactor.

20.3.1.10 Signalling cables shall be protected with RCC/ Half Split DWC duct with cover in **Station area** from Home to Home Signals of the station area as given in **Appendix-2 (Guideline for cable laying).**

20.3.1.11 Outside station area i.e. beyond Home Signals, the Signalling cable shall be protected with **'B' class** bricks of good quality.

20.3.1.12 Signalling and Telecom cable shall be laid in separate trenches to the extent possible. If not possible a brick separation shall be provided.

20.3.2 Cable core allocation

20.3.2.1 A cable core distribution plan shall be prepared for each installation.

20.3.2.2 Preferably 6/12/19/24 core out door signalling cables shall be used to keep low the inventory requirement.

20.3.2.3 Adequate spare conductors to a minimum of **20% of the total conductors** used shall be provided for each main cable upto home signal and **10% upto distant signal**. All branch/tail cables shall have at least **10% spare cores** or 2 cores, whichever is more. The spare conductors shall be provided in the outermost layer. All spare cores shall be made through up to the end points and terminated. For distant signals **double core** shall be provided for each function.

20.3.2.4 Where a number of cables have been used, the circuits shall be so distributed that the cables can be disconnected for maintenance purpose with the least possible dislocation to traffic. Line wise and function wise cables shall be provided.

20.3.2.5 A separate cable shall be used for operation of point/ crossover. **Operation and detection circuit** shall work on different cables.

20.3.2.6 **UP and DN track vacancy detection systems** shall be in different cables.

20.3.2.7 The quad cable used for signalling functions shall also **have 20% (of the total conductors used) spare** conductors.

20.3.3 Cable Route Plan

20.3.3.1 After deciding the size and the number of conductors in the different types of cables to be used on a route, a foot survey along the track shall be done to determine the best route for the cable.

20.3.3.2 While planning the cable route, any future yard modification etc. shall also be kept in view.

20.3.3.3 As far as possible low-lying areas, platform copings, drainages, hutments, rocky terrains, points and crossings, shall be avoided.

20.3.3.4 The cable route plan shall **show the actual alignment of track, giving offsets from permanent way** and permanent structures at regular intervals. The diagram shall indicate the various **road and track crossings, crossing with electric power cables, water and sewage lines** and other items of importance.

20.3.3.5 All cable routes shall be carefully coordinated with all the interfacing parties. The cable

trenching work shall be taken in hand only when the cable route plan has been approved by the Engineer.

20.3.3.6 The cable shall be laid in the HORC/IR land only.

20.3.4 Storing & transportation of cable

20.3.4.1 Cable drums shall not be stacked on flat side. Suitable stoppers shall be placed for stability.

20.3.4.2 Cable drums shall have easy access for lifting and moving.

20.3.4.3 When rolling the cable drum either for unloading or transportation, the drum shall always be rotated in the direction of the 'arrow' which is marked on the drum.

20.3.4.4 The drums shall not be rolled over objects that could cause damage to the protective battens of the cable.

20.3.4.5 When unloading is carried out from the vehicle the drum shall not be dropped on the ground directly to avoid damage due to impact. Fork lifter or ramp shall be used.

20.3.4.6 During all stages of storage, it is essential that the ends of the cable are effectively sealed by end cap or in any other approved manner to avoid water entry into the cable.

20.3.4.7 It is desirable that cable drums are stored in covered shed to protect against direct exposure to sun/ rains.

20.3.5 Paying out the cable

20.3.5.1 For paying out cables, the cable drums shall be mounted on cable wheels. It shall be ensured that no kink is formed while paying out the cable.

20.3.5.2 Cable drum shall never be kept on its side and cable uncoiled since this can result in twisting of cable conductors resulting in damage to them.

20.3.5.3 The drum on the wheel shall be brought to one end of the trench and the end of the cable freed and the cable shall be laid along the trench.

20.3.5.4 The cable drum shall be brought as close to the cable trench if possible. The cable drum shall clear the ground by 5 to 10 cm.

20.3.5.5 The wooden battens on the drums shall be carefully removed shortly prior to laying and before the drum is mounted on the jack.

20.3.5.6 A party of labourers shall move along the trench carrying cable at suitable intervals so that cable is not damaged due to dragging along the ground or bent unduly.

20.3.5.7 The in-charge of cable laying shall ensure proper synchronization of all labourers for smooth laying.

20.3.5.8 In cases where the wheels are not available, the drum shall be mounted on an axle at one end of the trench and cable paid out and carried by labourers.

20.3.5.9 In no case, shall the drum be rolled off on to the road for laying the cable and the cable dragged on the ground for laying purposes.

20.3.5.10 Whenever mechanized equipment is used, the work shall be carried out by a trained operator under the supervision of the Engineer or its authorized representative.

20.3.5.11 Where the cable drum is in damaged condition the cable may be placed on a horizontal

revolving platform and the cable paid out in the same manner as given in paras above.

20.3.5.12 Paying out of cable shall be done by rotating the cable drum and not by pulling the cable with excessive force.

20.3.5.13 Wherever flaking of cable is required, it shall be done by making a succession of loops in the form of Figure '8', these loops being disposed on top of each other to avoid tangling of cable. Figure of '8' flaking shall only be carried out under the direct supervision of an experienced official.

20.3.6 Excavation and backfilling of the trenches

20.3.6.1 Manual trenching is recommended for laying of Signalling cables in the station yards from Home-to-Home signal and mechanized trenching is recommended beyond the Home signal.

20.3.6.2 Digging of trench between IR track and HORC track shall be manual or mechanized as proposed by the contractor as per site survey/ feasibility and approved by the Engineer for every Station & Block section separately.

20.3.6.3 Excavation of Cable Trench shall be made in all kinds of soils including clearing roots of trees, rocks, etc. During excavation, the earth of the trenches shall not be thrown on the ballast. The earth shall be thrown by the side of the trenches away from track.

20.3.6.4 Trenches shall be straight as far as possible and steep angles shall be avoided.

20.3.6.5 The width of manually made cable trenches shall be commensurate with number of cables. The minimum width shall be kept as **0.3 metres.**

20.3.6.6 It is desirable that the excavation of the trenches is not done in long lengths and does not remain uncovered for long period. It is preferable that cables are laid and refilling done on the same day.

20.3.6.7 Before commencement of the laying, inspection of the trench and inspection of protection works shall be carried out by the Engineer so as to ensure their conformity with the specification.

20.3.6.8 After cable has been laid and until the whole of the cables to be laid in the trench have been covered with their protective covers, no sharp metal tool such as spades, crowbar or fencing pins shall be used in the trench or placed in such a position that they may fall into the trench.

20.3.6.9 For **road/platforms/railway track crossing**, trenchless horizontal directional drilling (HDD) technique shall be adopted under the supervision of competent staff for laying of RCC/GI/DWC-HDPE pipe. Both ends of RCC/GI/DWC-HDPE pipes shall be closed properly using accessories and the pits shall be properly backfilled. There shall be no damage to the road/platform/tracks or any such structures etc. enrooted during or after the HDD operations.

20.3.6.10 Backfilling of the trenches shall be done properly. The earth excavated shall be put back on the trench rammed and consolidated.

20.3.7 Cable Laying underground

20.3.7.1 The cables may be laid underground, either in the trench, in ducts, in cement troughs, in pipes or in any other approved manner.

20.3.7.2 Cable laying in ducts-RCC ducts/ Half split DWC pipe be used for laying the cable from

Home-to-Home Signal in Station yard. The ducts shall have suitable covers and shall rest on walls of duct as per Appendix-2 (Guidelines of cable laying).

20.3.7.3 The cables shall generally be laid keeping in view all the relevant provisions of Signal Engineering Manual of IR and the Joint Procedure order for undertaking digging work in the vicinity of S&T underground cables (Appendix-3 of the document).

20.3.7.4 Before commencing work on any part of the site, the Contractor shall ascertain that the Engineer and also, where applicable, the local and statutory authorities or other bodies/ persons concerned have reviewed the cable route. The Contractor shall further ensure that all necessary permits in such cases have been obtained and notices served.

20.3.7.5 Every precaution shall be taken to ensure that cables and equipment are not installed in a manner or under conditions likely to cause electrolytic or other corrosive action or damage to, or be detrimental to, the performance of the cables and equipment during operation.

20.3.7.6 Signalling cables shall not run with cables carrying high voltages or heavy currents and shall conform to the requirements specified in BS 7671.

20.3.7.7 Signalling tail cables shall be mechanically protected by DWC pipe to avoid being damaged from track side maintenance activities and shall be immune to any malfunction from electromagnetic interference.

20.3.7.8 All cables shall be laid along the track preferably **One metre** inside the HORC/ IR boundary. If it is necessary to lay the cable outside the HORC boundary it shall be laid on the berm with interface with Civil contractor with the approval of the Engineer. After Back filling Compaction of the formation shall be done properly.

20.3.7.9 The cable laid parallel to the track shall be buried at a depth of minimum 1.0 metre (top most cable) from ground level However, in case of rocky soil, the depth may be reduced suitably with pre cast cement concrete slab of minimum 10 cms. thickness provided for protection of cables. When it concerns the laying of tail cables which serve the track apparatus etc., the depth shall not be less than 0.50 metres.

20.3.7.10 No sharp object like stone chips, iron pieces etc. shall ever come in contact with laid cables irrespective of the method of laying the same. The bottom of the cable trench shall be levelled and got rid of any sharp materials. In the soft ground, the cable shall be laid at the bottom of the trench previously levelled. In both the above cases, the cable shall be covered with a layer of sand or sifted earth of 0.10 metre thickness and thereafter a protective cover of trough or a layer of bricks shall be placed in block section and half split DWC pipe in station area shall be placed.

20.3.7.11 At each end of the main cable an extra loop length of **4 to 5 metre shall** be kept.

20.3.7.12 Before starting cabling work, location boxes shall first be erected so that cable after laying is directly taken inside location box and its multiple handling/ damage by re-digging and taking inside Location box/ Signal equipment Room is eliminated.

20.3.8 Cable Laying in Electrified area

20.3.8.1 The cable shall be laid at not less than three meter from the nearest edge of the mast foundations supporting the catenary or any other live conductor. When laying upto 1m from the OHE structure, the depth of the cable does not exceed 0.5 meters with suitable cable protection measures provided. If it is difficult to maintain these distances, the cable

shall be laid in concrete/ heavy duty HDPE/ Ducts or any other approved means for a distance of 3 metres on either side of the Mast. When so laid, the distance between the cable and mast may be reduced to 0.5 meters. The precautions are necessary to avoid damage to the cable due to surge/ heavy current in the event of the failure of an overhead insulator.

20.3.8.2 In the vicinity of traction sub stations and feeding posts, the cable shall be laid at least one metre away from any metallic part of the O.H.E. and other equipment at substation, which is fixed on the ground, and at least five metre away from the substation earthing. In addition, the cable shall be laid in RCC pipes/ or other approved means for a length of 300 metres on either side of the feeding point. As far as possible, the cable shall be laid on the side of the track opposite to the feeding post.

20.3.8.3 In the vicinity of the SP/SSP, the cable shall be laid at least one metre away from any metallic body of the station, which is fixed in the ground, and at least 5 metres away from the station earthing. The distance of 5 metres can be reduced to one metre provided the cables are laid in RCC/GI/DWC/HDPE pipes or any other approved means.

20.3.8.4 Where an independent Earth is provided for an OHE structure, i.e. where the mast is connected to a separate Earth instead of being connected to the rail, the cables shall be laid at least one metre away from the Earth.

20.3.8.5 Where there are O.H.E. structures along the cable route, the cable trenches shall be as far as possible, be dug not less than 5.5 metres away from the centre of the Track.

20.3.9 Laying of different type of cable in same trench

20.3.9.1 The OFC cable shall be laid/ blown in lubricated HDPE pipe as per Telecom manual.

20.3.9.2 Where several cables of different categories have to be laid in the same trench, they shall be placed as far as possible in the following order starting from the main track side, so that in the event of failures, the maintenance staff may easily recognize the damaged cables:

(i) Power cable of S & T

(ii) Signalling cable

(iii) Telecommunication cable

20.3.9.3 A distance of approximately **10 cm must be** maintained between Telecommunication cable and Signalling cables. The Signalling cables must be separated from power cables/Telecom cables by a row of bricks placed between them as per sketch shown in Appendix-2(Guidelines for cable laying) of this document.

20.3.10 Cable laying in ducts

20.3.10.1 Cables in rockey or rock mixed soil area shall be laid in appropriate pipes/ duct.

20.3.10.2 Cables for longer distances shall be laid on bottom layer. Duct shall be filled with sand after cable is laid to avoid entry of rodents.

20.3.10.3 The ducts shall be of such design as to prevent collecting the water in the duct.

20.3.10.4 Cables in any conduits, trunkings or ducts shall not occupy cross-sectional space in excess of 50%.

20.3.10.5 When cables are laid in trunking/ RCC duct, care shall be taken to see that no ballast or

stones have been dropped inside the trunking/ RCC duct. The trunking/ RCC duct shall be cleared of all ballast and stones before the cover are secured. When the ends of covers are joined together with cement plaster, a piece of paper or wood shall be placed under the joint to prevent the cement plaster from falling on the cable.

20.3.10.6 After placing the trunking/ RCC duct in the trench the ducts have to be aligned using 8 mm rod. For this purpose, a hole is left in the trunking/ RCC duct for insertion of rods. Wherever there is a diversion proper care shall be taken to cover the cables, either by smoothly forming a curve with duct or a masonry structure can be constructed to protect the cables. After laying of cables the ducts shall be covered with RCC slab and shall be continuously plastered at the end with trunking/ RCC duct.

20.3.10.7 Where it is necessary to take the cables between the tracks, it shall be carried in trunking/ RCC duct kept sufficiently below the ballast level.

20.3.10.8 In station area the S & T cables shall be laid in RCC/ Half split DWC duct as per sketch given in Appendix-2 of this document.

20.3.11 Cable Laying in Solid & Rocky soil

20.3.11.1 In case of rocky soil, the depth may be reduced suitably.

20.3.11.2 Sharp edges on the sides must be smoothened out and bottom of the chase shall be levelled. In the rocky ground the cable shall be laid normally on layer of sifted earth of 50 mm thickness previously deposited at the bottom of the trench. Cable shall be covered with the layer of sand or sifted earth of 100 mm thickness.

20.3.11.3 In case sharp edge of rocky ground cannot be protected with sifted earth, concrete/ RCC/GI/DWC-HDPE pipe shall be used if numbers of cables are small. If number of cables is large, RCC duct shall be used. In isolated cases, it can be given smooth surface by using either masonry bricks or cement concrete.

20.3.11.4 A row of bricks shall then be placed lengthwise on the top and jointed with cement mortar and a layer of concrete with cement plaster shall be provided on the top of the same.

20.3.11.5 A sketch showing laying of cables in rocky area is placed at Appendix-2 of this document.

20.3.12 Laying in special soil condition: Cable shall not be run through abnormally high acidic or alkaline soil or through sewages. If this is unavoidable special measures shall be taken to prevent corrosion. Cable may be laid in the concrete/ RCC/ GI/ DWC-HDPE pipes properly jointed to prevent ingress of moisture.

20.3.13 Cable laying in residential area: When laying the cable in residential area, the cable shall be specially protected on both sides up to a distance of about 50-100 metres beyond the building line subjected to approval of Engineer. In such cases, the cable shall be protected by means of concreting of 50 mm as proposed for rocky soil/ in concrete/ RCC/ GI/ DWC-HDPE pipes. This is better than using bricks as in a residential area bricks are usually found while digging and its special significance of cable protection may be overlooked.

20.3.14 Track crossing

20.3.14.1 As far as possible, the cable shall be crossed from one side of the yard to theother, at minimum number of locations.

20.3.14.2 Track crossing shall be **through trenchless** method. The following precaution shallbe taken:

- The cable crosses the track at right angles.
- The cable does not cross the track under points and crossings.
- The cable is laid in concrete/RCC/GI/DWC-HDPE pipes or suitable ductsor in any other approved manner while crossing the track.
- Cable laid across the track must be 1.0 metre (minimum) below the bottom of the rail.
- No digging shall be done below the sleepers.
- A sketch showing track crossing is placed Appendix-2 of this document.

20.3.15 Road crossing

20.3.15.1 Road crossing shall be done through **trenchless** method. The cable shall be laid in concrete/ RCC pipes or in any other approved manner while crossing the road at the depth of **1 metre from the ground** level. It shall extend **1 metre (minimum)** on each side of the road keeping in view the future increase of width of the road.

20.3.15.2 When crossing roads, it is necessary to lay the cables in such a manner as to avoid the necessity of bending the cable sharply and minimize the excavation of road surface as far as possible.

20.3.15.3 The crossing of main roads often involves difficulties, especially if traffic is heavy. Precautions to avoid accidents to workmen, pedestrians and vehicles shall be taken. On minor roads, which can be temporarily closed to traffic it is possible to open up across the entire width of the road, pipes shall be installed quickly in the cutting, which is then filled in there by reducing to a minimum the time for which the road is closed.

20.3.15.4 Some roads, which are broad, may be opened for half their width allowing the other half for use of traffic, pipes are laid, trench filled in the first half and the other half opened up after the first half is opened half is linked with those laid in the first half.

20.3.15.5 Whenever a cable is laid across an important road, particularly one with a special surface, space for future expansion may be provided. Either of the following methods may be adopted:-

- The size of the pipe shall be so chosen that provision for laying of additional cables in future is kept. Pipes having diameters ranging from 100 to 200 mm are suggested, or
- A spare pipe may be laid, through which a cable can be drawn when required. It will be advantageous to leave a lead wire of G.I wire in the pipe for drawing the cable in future.
- A separate pipe of suitable diameter shall be used for telecommunication cable.
- A sketch showing track crossing is placed at Appendix-2 of the document.

20.3.16 Cable laying on bridges/culverts

20.3.16.1 Wherever practicable, the cable may be taken underground across the drain bed at a suitable depth for crossing small culverts with low flood level. A sketch No. showing

cable laying on culverts with low flood level is placed at Appendix-2 of this document. Wherever cable may not be taken underground across the drain bed, cable shall be taken on the approach slopes of culvert through **GI pipe** of suitable sizes **with concrete cover** and blocks. A sketch No. showing cable laying on culverts with high flood level is placed at **Appendix-2** of this document. The same may be used by the S&T contractor for laying of S&T cables. The cables in these ducts shall be laid in **HDPE/ DWC** pipes.

20.3.16.2 When cables have to cross a **Girder bridge**, they shall be placed inside a GI pipe/ metallic through (filled with an anti-theft measure as sealing compound). The cable shall be supported across the bridge in a manner which would involve minimum vibrations to the cable and which will facilitate maintenance work. Adequate cable length to the extent 5 to 6 meters shall be made available at the approaches of bridge. A sketches showing cable laying on metallic bridges are placed at Appendix-2 of this document.

20.3.16.3 In case of arch bridges, cable shall be taken through **GI pipes on top of** the arch adjoining the parapet wall. The pipe shall be covered with ballast. Cement Concreting of 50 mm shall be done throughout from entry/exit end of cable up to diversion point including slope on either side. The entry and exit ends of the cable from the pipe to the diversion point of the cable shall be concreted for 1 metre (minimum). A sketches showing cable laying on arch bridges are placed at Appendix-2 of this document.

20.3.16.4 On PCC/ RCC box Bridges . All Outdoor Signalling cables and Telecommunication Cables (OFC cable, Telecom Quad Cable & PIJF Telephone Cables etc.) on these Concrete Bridges & Culverts shall be laid inside DWC Pipes. OFC cable shall be laid inside the HDPE duct. **Entry/ Exit of the Cables to/ from Bridges & Culverts** shall be suitably protected by concrete cover. The Contractor shall carry out necessary co-ordination with Civil, Structure & Track Contractor in this matter. Cable shall be laid in **Double Wall Corrugated Pipes** in the slope to climb from ground to top level of bridges. It shall be so laid to maintain a continuous depth of 1 meter (top of DWC Pipe) from the nearest ground level. The slope of track formation shall be restored to its original condition after laying of cables.

20.3.16.5 On Girder bridges, GI pipe shall be laid on the top level of the bridges on both sides of the track.

20.3.16.6 As the laying involves movement of a large number of staff over the bridge the line shall be blocked and flagman posted on other side. On a double line only the line near which cable is being laid shall be blocked but care shall be taken to see that staff is aware of this and measures taken to prevent staff from straying on to the unblocked line.

20.3.16.7 Damage to cable is likely to occur if care is not taken in laying cable where the bed changes from solid support such as a foundation, pier of bridge to soft support such as soft soil. The cable must not press against the edge of the solid support. The soft soil near the edge must be tamped and the cable raised slightly.

20.3.16.8 In order **to prevent theft and miscreant** activities on approach of cable to bridge/ culvert where it is not possible to ensure adequate depth, **concrete protection** is proposed.

20.3.16.9 To cross the bridges full DWC pipe shall be provided on the slope at the **distance of about 500mm from the retaining wall edge**.

20.3.17 Cable Laying in monsoon season

20.3.17.1 Cable laying in monsoon when the precipitation is heavy shall be avoided. The trenches will be inundated and visual inspection of the bedding of the trench will be rendered difficult. Threading the cable in pipes will also be more difficult.

20.3.17.2 When cable laying is necessary during the rainy season, the cable ends shall be inserted in a pipe sealed at one end and the pipe buried. Termination work shall be started only when there is likelihood of a clear weather for three to four days.

20.3.18 Laying of cable above ground

20.3.18.1 Signalling cables for outdoor circuits shall not normally be laid above ground. In exceptional cases where it becomes unavoidable, the following precautions shall be taken:

- The cable shall be suspended in wooden cleats, from cable hangers or in any other approved manner so that no mechanical damage occurs to the cable even under exposed condition.
- The cable supports shall be so spaced as to avoid sag.

20.3.18.2 **Indoor Signalling cable** shall normally be laid on ladders, channels or in any other approved manner. The cables shall be neatly tied/ laced.

20.3.18.3 In AC electrified areas cables shall be laid underground only. For laying cables in RE area instructions laid down in IRSEM shall also be followed.

20.3.19 **Cable markers:** Underground Cable Route shall be identified by **Concrete Cable route Markers** directly buried inside the trench at 5**0 m interval** and at diversion and track crossing points within the Station section from home to home with the approval of Engineer. Outside station section **normal concrete type cable route route marker** as per sketch given in Appendix-2/6 of this document shall be provided **at every 50 m interval and at diversion and track crossing points** with the approval of Engineer It shall also be provided at entry/ exit of track/ road crossing etc. during crossing of bridge on the ground level, on mid of slope, at diversion etc.

20.3.20 Entry of cable at cabin, relay room, location boxes etc.

20.3.20.1 All cable entry points in the Signal/ Telecom Equipment room, Battery room, SM's room, IPS room, MSDAC room at Station or S&T Huts, Location boxes, Junction boxes etc. shall be **properly sealed** using modular based cable and pipe sealing system/ other approved means. All cable entries from/ to adjacent rooms through overhead duct/ ladder shall also be sealed.

20.3.20.2 All cable entrance ducts must **be closed with suitable masonry works, sand covered and plastering** to prevent entry of rats etc. RCC slab shall be provided on the cable pit of the Signalling/ Telecom equipment rooms at the Stations and S&T Huts.

20.3.20.3 Cable shall be protected on both sides up to a distance of **10 metre beyond building line** of Signalling/ Telecom equipment rooms, Battery room, Power supply room, SM's room of Station and S&T Huts.

20.3.20.4 Damage to cable is likely to occur if care is not taken in laying cable where the bed changes from solid support such as a foundation/ masonry to soft support such as soft soil. The cable must not press against the edge of the solid support. The soft soil near the

edge must be tamped and the cable raised slightly.

20.3.21 Termination of cables

20.3.21.1 No jointing of Signalling cables is permitted. All cables shall be terminated.

20.3.21.2 The cable termination of Signalling cables shall be undertaken on approved type of terminations with ease of maintenance and disconnection facility on CT racks/ location boxes/ junction boxes.

20.3.21.3 All wire and cable conductors shall be clearly identified and numbered at each end using durable shrink on or tag type labels. A description of the terminating function shall be included. Each core so terminated shall be provided with identification marking on cable and on conductors/ terminals and ferrules with letters or/ numbers embossed on them as per requirement of circuitry. This will enable easy identification of conductors in case of any failures or cable disconnections or cable cut by outsider/ miscreants. A proper marking and termination practice ensures quick and easy restoration during failures.

20.3.21.4 Unused cable cores/ pairs of multi-core/ pair cables shall also be terminated and marked so.

20.3.21.5 Crimping or other standard industry practice shall be used for terminating all conductors. Solder terminations shall only be used with the approval of the Engineer.

20.3.21.6 Wherever practical, multiple pin plugs and sockets shall be used to connect multi- core cables and wiring loops to all items of equipment. These shall have some form of keying to prevent incorrect equipment modules from being installed.

20.3.21.7 The cable terminations shall be secured enough to withstand vibration level that is likely to be experienced in the HORC environment.

20.3.22 Cable Termination Rack (CTR) and Location Box

20.3.22.1 Cable Termination Rack (CTR) with **20% extra** capacity for future expansion shall be provided.

20.3.22.2 **Only screw less terminals with isolation facility** shall be used for cable terminations. The terminals and fuses used shall meet the requirements of RDSO specification described in Chapter-4 of this document with latest amendments. If any alternative terminal type is proposed for use, it should be got approved by the Engineer.

20.3.22.3 All external power/ signalling / data lines susceptible to lightning or high induced voltage shall be provided with **Stage-3 surge protection devices** as per available Para of this specification.

20.3.22.4 The Cable Termination Rack (CTR) shall be equipped with copper earth bar to which all cable shields shall be connected and soldered. The copper earth bar shall be connected to the earth.

20.3.22.5 The Outdoor cables shall be terminated in Location Boxes.

20.3.22.6 Location boxes shall be rugged and free from ingress of rodents, insects, dust, moisture and water.

20.3.22.7 Location boxes shall be able to withstand vibration level, likely to be experienced alongside the track.

20.3.22.8 Location boxes shall be theft and vandal proof as far as possible and shall be able to

withstand the climate of the region.

20.3.22.9 Cable entry points in the location boxes shall be filled with sand and plastered with cement.

20.3.22.10 Separate Location boxes shall be used for UP and DN line cables.

20.3.22.11 All location boxes shall be provided with 110 V AC LED lighting arrangement with ON/ OFF switch to assist maintenance/repair work undertaken during night.

20.3.22.12 The installation of Location boxes shall not be done on loose earth/ water logger area. It should be installed on proper concrete foundation. The foundation drawing shall be proposed by the Contractor and approved by the Engineer.

20.3.23 Testing of cable

20.3.23.1 Before the cable is laid in the trench, a visual inspection of cable shall be made to see that there is no damage to the cable. It shall be tested for insulation and continuity of the cores. Thereafter, the cable shall be laid into the trench. Record of insulation and loop resistant must be maintained.

20.3.23.2 Testing of all main and Tail cables after laying of the cable in trenches and also after termination in apparatus cases, in boxes and in relay room shall be done.

20.3.23.3 If any defect is noticed during the testing after laying the cable the same shall be replaced.

20.3.23.4 The insulation resistance tests shall be made when conductors, cables and insulated parts are clean and dry. An insulation tester shall be used for insulation testing. Any metallic sheath or metal work of any rack or apparatus case shall be bonded to earth during test.

20.3.23.5 Insulation Resistance so measured shall not be less than 5 mega ohms per km at buried temperature. If the insulation resistance is found to be lower than 5 mega ohms, the cause shall be investigated and immediate steps taken to repair or replace the cable to prevent any malfunctioning of the equipment and circuits.

20.3.24 Supervision of cable laying: The work shall be supervised personally by an official authorized by the Engineer. The cable trench shall be inspected by the authorized person and jointly signed by him/ her and the Contractor's authorized person before cable laying is undertaken on the request for inspection (RFI). The record of joint inspection of the trench shall be maintained.

20.4 EARTH LEAKAGE DETECTOR (ELD)

20.4.1 ELD shall be provided to detect earth faults in the Signalling cables and circuits.

20.4.2 ELD and alarms shall be provided at all the Signalling equipment rooms at the stations and at S&T Huts. ELD provided should cover all the Signalling cables and DC/AC power supplies/ cables.

20.5 EARTHING AND BONDING

20.5.1 General: Earthing shall be provided for all Indoor & Outdoor Signalling installations to achieve the following objectives:

20.5.1.1 Efficiently dissipate heavy fault currents and electrical surges, both in magnitude and duration, to protect equipment from being damaged so as to minimize down time, service interruption and replacement cost.

20.5.1.2 Provide a stable reference for electrical and RF circuits at the installation to minimize

noise during normal operation.

20.5.1.3 Protection of personnel who work within the area from dangerous electric shock caused due to "step potential" or "touch potential".

20.5.1.4 To achieve the primary goal of assuring personnel safety and damage control, a low impedance path shall be made available to the current generated due to lightning or power system fault. The potential differences between any two points shall be as low as possible. Safety considerations also require the equipment chassis or enclosure to be earthed to minimize shock hazards to system staff.

20.5.1.5 To achieve the secondary goal of providing protection for sensitive and interconnected electronic and electrical systems, earthing shall be designed to minimize the noise voltage generated by currents from two or more circuits flowing through common earth impedance and to avoid creating earth loops susceptible to magnetic fields and differences in earth potential.

20.5.1.6 The Earthing and Bonding system shall meet or exceed the requirements of IEEE 1100, NFPA 780, IEC 62561-7 and IEC 62305.

20.5.1.7 To minimize the effect of circulating earth loops and to provide equipotential bonding, "star type" bonding connection shall only be provided as required.

20.5.1.8 The contractor shall submit the design for Earthing and Bonding of Signalling and Telecommunication systems for review and approval by the Engineer. OEM's original data sheets of the proposed devices shall also be submitted along with the protection methods adopted in their design.

20.5.2 Indoor Signalling installation

20.5.2.1 The Equipment rooms housing Indoor Signalling equipment and their Power supply shall be provided with suitable Earthing and Bonding system.

20.5.2.2 There shall be one equi-potential earth busbar for each of the equipment rooms viz. Signalling equipment room, Power supply equipment room etc. The equi- potential earth bus bars located in individual rooms shall be termed as Sub equi-potential busbars (SEEB). The equi-potential earth bus bar located in the Power supply equipment room directly connected to Class 'B' SPD and the main earth pit shall be termed as Main equi-potential earth busbar (MEEB).

20.5.2.3 The EEB shall have pre-drilled holes of suitable size for termination of bonding conductors. The EEB shall be insulated from the building walls using low voltage fire resistant insulators. All terminations on the EEBs shall be using copper lugs with spring washers.

20.5.2.4 All the equipment/ racks in the Equipment room shall be directly connected to its SEEB. Each of Sub-equipotential earth busbar (SEEB) installed in the rooms shall be directly connected to Main equipotential earth busbar (MEEB) using bonding conductors.

20.5.2.5 The routing of bonding conductors from equipment/ racks to SEEB and from SEEB to MEEB shall be as short as possible and direct with minimum bends and separated from other wiring. The connection from SPD to MEEB shall be as short as possible and preferably without any bend.

20.5.2.6 The connection between any two moving parts like doors with Bonding Ring Conductor, etc. shall be connected by 316L Stainless Steel Flexible braids, which are UL listed,

RoHS compliant and meeting IEC 60439.1 & IEC 61439.1.

20.5.2.7 All bonding connections, whether it is from equipment or SPD to respective lugs on bus bars or of the Main earth bond with the Main Earth electrode, shall be with stainless steel nuts and bolts and exothermic welding while keeping in mind the conditions of UL listing, IEEE 837 & tamper proof weld metals.

20.5.2.8 The Earthing system shall use maintenance free loop earth as per RDSO specification described in Chapter-4 of this specification with latest amendment and shall be designed to give an earth resistance of less than 1 ohm. The design should be based on calculation methods as per IEEE 80 which require the parameters like target ohmic resistance value, soil resistivity, electrode length, electrode diameter etc. SM room equipment, Signalling equipment rooms/ Object controller equipment room, IPS room, MSDAC room etc. shall be connected with this earth.

20.5.2.9 The earth electrode shall be made of high tensile low carbon steel circular rods, molecular bonded with copper on outer surface to meet the requirements of UL 467. The Ground Enhancement material should meet the requirement of IEEE 80's Clause 14.5 (d) and should be tested as per IEC 62561-7 standard. All the earth electrodes shall be bonded together using Galvanized Steel tapes or Copper Bonded Steel Conductors of suitable size in continuous length of max. up to 100 metre to achieve equipotential bonding. For Power supply equipment, MSDAC equipment etc. separate maintenance free earthing arrangement shall be provided.

20.5.2.10 Despite the provision of earthing, as specified above, if failures of Solid state electronic equipment occur on account of finite earth resistance, particularly due to high voltage transients and lightning, further protection as necessary shall be provided.

20.5.3 Outdoor Signalling installation

20.5.3.1 All the Outdoor Signalling equipment viz. Signals, Location boxes etc. shall be provided with suitable Earthing arrangement with earth value **< 5Ω.**

20.5.3.2 The target earth resistance value for outdoor Signalling equipment shall be in accordance with the requirement specified for the equipment by the OEM/RDSO specification.

20.5.3.3 The Signalling equipment having Solid State components and the enclosures housing them shall be provided with maintenance free earth using copper bonded steel electrode, earth enhancement compound and bonding connection through exothermic welding as per RDSO specification described in Chapter-4 with latest version and amendments. Each MSDAC DP shall be provided separate one maintenance free earth electrode or more with Earth value shall be **<1Ω.**

20.5.3.4 In order to arrive at the required target resistance value, the number of earth electrodes should be decided based on the calculations involving soil resistivity as per the standards above, all interconnected in parametric ring form or in parallel manner.

20.5.3.5 Where the equipment to be earthed are in close vicinity they should be connected to a common earth in star configuration.

20.5.3.6 For **outdoor Signalling items installed in Location boxes**, One earth busbar of suitable size shall be provided in each location box and earth point of all equipment and cable armour etc. shall be terminated on this busbar. This busbar shall be connected to normal earthing electrode.

20.5.3.7 **All Apparatus Cases and Signals shall be earthed with General/ Conventional earth pit.** Multi-strand single core PVC insulated copper cable as per IS:694, **10 Sq mm cable** shall be used to connect the Apparatus cases of signals with the earth pit. Cable shall be protected with the conduit.

20.5.3.8 **GI wire as earthing bond** shall not be used.

20.5.3.9 All earth pits shall be concrete and have **concrete cover, painting of earth value and date of testing.**

20.5.4 Lightning Protection

20.5.4.1 All the structures housing Signalling and Telecom equipment viz. SER, TER, S&T Power supply Equipment rooms and other S&T rooms at Station, S&T Huts, Centralised tunnel control centre shall be provided with **lightning protection arrangements** and protection against lightning surges travelling through conductors into equipment by using appropriate devices.

20.5.4.2 The external Lightning protection arrangement shall have an air termination system, down conductors and Earthing system complete with accessories.

20.5.4.3 The Lightning Air Terminal should be installed at a height at least 3m more than the top most projection of the building.

20.5.4.4 The air termination system shall be connected to the earth electrode of earthing system using down conductor of Copper Bonded Steel Conductor or any other suitable material as approved by the Engineer. The Down conductors shall be installed straight and vertical such that they provide the shortest and the most direct path to the earth.

20.5.5 Surge Protection

20.5.5.1 The Surge protective devices shall be provided at the **input and output power supplies** to protect the Power supply equipment and the load equipment against any power surge due to lightning, switching, etc. The Surge arrestors shall also be provided for protection on external power/signalling/data lines.

20.5.5.2 All surge protection equipment shall be grouped together in close proximity to the main earth bus bar and be physically and electrically isolated from other signalling equipment.

20.5.5.3 The Surge Protection System provided shall comply with specifications described in chapter-4 of this document.

20.5.5.4 Surge Protection for Indoor Signalling equipment shall be provided as under:

20.5.5.4.1 Stage-1 Protection (at the entry point of input 230V AC supply in the power supply equipment room)

a) The Stage-1 protection shall consist of coordinated Class I/ B & II/ C type SPDs at the entry point of input 230V AC supply in Power supply Equipment room in TT configuration in a separate wall mountable box. The Class I/B SPD shall be provided between Line to Neutral & Neutral to Earth. They shall be spark gap type voltage switching device and tested as per relevant specifications described in chapter-4 of this document with the following characteristics and features:

S.No.	Parameters	Line &Neutral
1	Nominal Voltage (U0)	230V
2	Maximum continuous operating voltage (Uc)	≥255V
3	Lightning Impulse current between 10/350ps (I_{imp})	≥25kA
4	Response time (Tr)	≤100 ñs
5	Voltage protection level (Up)	≤ 2.5kV
6	Short circuit withstand and follow up current extinguishing capacity withoutback up fuse (Inc & Ifi)	≥ 3kA
7	Temporary Over Voltage (UT)	334V min. for 05 secs.
8	Operating temperature / RH	- 25°C to +80°C/95%
9	Mounted on	DIN rail
10	Indication	Mandatory
11	Pluggability	Optional
12	Potential free contact for remote monitoring	Optional
13	Encapsulation	Encapsulated
14	Degree of protection	IP20
15	Housing	Fire retardant as per UL 94

b) The Class-I/ B SPD will be followed by Class-II/ C SPD adjacent to it and connected between Line & Neutral. The device shall be a single compact varistor of proper rating and in no case a number of varistors shall be provided in parallel. It shall be voltage clamping device, thermal disconnecting type and shall be tested as per IEC 61643 with the following characteristics and features: -

S.No.	Parameter	Limits (Between Line & Neutral)
1	Nominal Voltage (U0)	230 V
2	Maximum continuous operating voltage (Uc)	≥ 300 V
3	Nominal discharge current 8/20 µs (In)	≥ 10 kA
4	Maximum discharge current 8/20 µs (Imax)	≥ 40 kA
5	Response time (Tr)	≤ 25 ñ sec
6	Voltage protection level (Up)	≤ 1.5 kV
7	Operating temperature / RH	- 25°C to + 80°C/ 95%
8	Mounted on	DIN rail
10	Indication	Mandatory
11	Pluggability	Mandatory
12	Potential free contact for remote monitoring	Mandatory
13	Degree of protection	IP20
14	Housing	Fire retardant as per UL 94

c) Class-I/B and Class-II/C SPDs of Stage-I shall be so coordinated that the voltage protection level of the coordinated devices is ≤ 1.5 kV. As such, these devices shall be from the same manufacturer and necessary test certificate in this regard shall be submitted by the manufacturer/ supplier. **This arrangement will provide least resistance path from line to neutral and neutral to earth when surges & lightning spikes hits the line there by bypassing the system. Earth pit resistance should be <2Ω.**

20.5.5.4.2 Stage-2 Protection (at the output side inside the distribution panel):

The Stage-2 protection shall consist of provision of Class-II/ C type SPDs for ≥ 24V-110V AC/DC supplies at the output side inside the rack of IPS. These shall be provided for External circuits i.e. Relay external circuit, Axle counter circuit, Point machine circuit and at Inverter output. The Class-II/C type SPD shall be a single compact varistor of proper rating and in no case a number of varistors shall be provided in parallel. It shall be voltage

clamping device and thermal disconnecting type. They shall be tested as per IEC-61643 with the following characteristics and features-

Lightning & Surge Protection arrangements in IPS for Signalling installations:

S.No.	Parameter	Limits (between L1 & L2, L1 & E, L2 & E)	
		Line & Neutral	**Neutral & Earth**
1	Nominal Voltage (U0)	60 V-110V AC/DC	24V-60V AC/DC
2	Maximum continuous operating voltage (Uc)	≥ 150 V (AC) ≥ 200 V (DC)	≥ 75 V (AC) ≥ 100 V (DC)
3	Nominal discharge current 8/20 µs (In)	≥10 KA	≥10 KA
4	Maximum discharge current 8/20 µs (Imax)	≥ 40KA	≥ 40KA
5	Response time (Tr)	≤ 25 ñ Sec	≤ 25 ñ Sec
6	Voltage protection level (Up)	≤ 1.0 KV	≤ 0.5 KV
7	Operating temperature / RH	- 25°C to + 80°C/ 95%	- 25°C to + 80°C/ 95%
8	Mounted on	DIN rail	DIN rail
10	Indication	Mandatory	Optional
11	Pluggability	Mandatory	Mandatory
12	Potential free contact for remote monitoring	Mandatory	Mandatory
13	Degree of protection	IP20	IP20
14	Housing	Fire retardant as per UL 94	Fire retardant as per UL 94

Length of all cable connections from SPDs to earth equi-potential busbar shall be kept less than 0.5 mtrs. For this, a sub earth equi-potential busbar shall be installed at approx. 20 cm from the SPD box.

20.5.5.4.3 Stage 3 protection (Protection for Power/ Signalling/ Data lines)

a) All external Power/Signalling/Data lines shall be protected using preferably pluggable Stage-3 surge protection devices, consisting of a combination of Varistors/Suppressor diodes and GD tubes with voltage and current limiting facilities.

b) These devices shall preferably have an indication function to indicate the prospective life and failure mode to facilitate the replacement of failed SPDs. If the device has any component which comes in series with data/signalling lines, the module shall have make before break feature so that taking out pluggable module does not disconnect the line. This protection shall be in compliance to IEC 61643-21 & VDE 0845 Pt. 3 with the following characteristics:

Nominal Voltage(U0)	5V	12V	24V	48V
Arrestor Rated voltage (U)	6V	13V	28V	50 V
Rated Load current (IL)	250 mA	250 mA	250 mA	250 mA
Total discharge current8/20 |JS (in)	20 kA	>20 kA	>20 kA	>20 kA
Lightning test current10/350 ps	a2.5 kA	*2.5 kA	*2.5 kA	a2.5 kA
Voltage protection level (Up)	s 10 V	s 18 V	s 30 V	1 70 V

c) If the Power supply/ Data/Signalling lines (AC/DC) are carried through overhead wires or cables above ground to any building or any location outside the equipment room, additional protection of Stage-2 (Class-II/C) type shall be used at such locations for power supply lines and Stage-3 protection for Signal/data lines.

(End of Chapter-20)

CHAPTER 21: TESTING AND COMMISSIONING

21.1 GENERAL

21.1.1 The general details of Testing and Commissioning Philosophy, Strategy, Program, Plan and procedures is covered in General Specifications (S&T). The specific requirements of Testing and Commissioning covered here shall be read in conjunction with the general requirements covered in GS (S&T).

21.1.2 Sequence of Tests: The sequence of tests shall generally comprise of the following:

21.1.2.1 Type Tests, as and when required;

21.1.2.2 Factory Acceptance Tests (FAT);

21.1.2.3 Installation Tests;

21.1.2.4 System / Sub-system Acceptance Tests (SAT);

21.1.2.5 Integrated Testing & Commissioning; and

21.1.2.6 Trial Run.

21.2 TYPE TESTS

21.2.1 Type tests are performed on sample of Equipment prior to full production. Type tests are used to confirm that the proposed equipment is fit for purpose in the environmental conditions specified and meets the requirements of the specification including the EMC.

21.2.2 Type tests are not required to be conducted on Equipment procured as per Para 4.2.1 of this specification.

21.2.3 The Type tests may be exempted if the Contractor is able to produce the Environmental and EMC test results earlier conducted on the Equipment and RDSO/ Engineer's representative are satisfied that the Equipment meet the required specification.

21.2.4 Type tests on equipment for which RDSO specification exists, if required shall be done as per applicable RDSO specification.

21.3 FACTORY ACCEPTANCE TESTS

21.3.1 The FAT is carried out to demonstrate that each equipment/ sub-system meets its functional specifications.

21.3.2 The FAT shall be carried out on all material, components, sub-assemblies, unit assemblies (including software, cables and wiring). 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. If any item/ equipment whether as per IRS/ RDSO specification or otherwise is proposed to be procured without FAT, the same should be done only with the prior approval of the Engineer.

21.3.3 FAT procedure shall be submitted for review by the Engineer Twenty-Eight **(28) days in advance** of carrying out any Test.

21.3.4 The FAT shall be witnessed by **Engineer's representative**. For equipment procured as per IRS/ RDSO specification and with RDSO inspection, FAT may be witnessed by Engineer's representative.

21.3.5 Where processor-based equipment is to be used, the FAT shall also include verification of application software.

21.3.6 Factory acceptance tests shall include but not limited to:

21.3.6.1 Physical inspection;

21.3.6.2 Layout and equipment profile;

21.3.6.3 Dimension check;

21.3.6.4 Electrical check;

21.3.6.5 Calibration;

21.3.6.6 Output check;

21.3.6.7 Operational performance;

21.3.6.8 Insulation test;

21.3.6.9 Soak test; and

21.3.6.10 Interface tests with other equipment.

21.3.7 The EI application logic/ software for every station will have to be tested completely for all tests including Control Table, Hot standby tests etc. as part of FAT. The controls/ logic that are not possible to be tested at the FAT stage shall be identified and tagged for testing at SAT stage, in consultation with the Engineer.

21.4 INSTALLATION TESTS

21.4.1 Prerequisites for Installation:

21.4.1.1 The Installation designs and drawings have been reviewed and approved by the Engineer.

21.4.1.2 Prior to installation, the Contractor shall ensure that equipment delivered to Site has not been damaged in transit and ensure for their dimensional accuracy.

21.4.2 **Pre-installation test/ inspection**: **Invoice, QA/QC test/ FAT report, Warranty certificate, OEM manuals** etc. shall be verified during this test/ inspection. RFI shall be submitted for this test/ inspection.

21.4.3 Post Installation tests and Inspection:

21.4.3.1 The Installation designs and drawings approved by the Engineer shall be referred during this test.

21.4.3.2 Post installation tests shall be carried out by the Contractor for each sub system following installation but before SAT to demonstrate that the installation has been carried out correctly.

21.4.3.3 Each test/ inspection shall have RFI reference. RFI shall be given to the engineer not less than **24 hours before** the schedule of test. All related approved drawings shall be kept by the contractor on this site during test/ inspection. Compliance of comments of engineer's representative shall be submitted with the proof as photographs/ documents etc. This test shall check **the availability of power, continuity of wiring, earthing, labeling, name plates, painting, SOD clearance** etc.

21.4.3.4 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.

21.4.3.5 The Installation shall be inspected by the Contractor and witnessed by the Engineer. The

Contractor shall submit a Post installation Inspection and testing Plan for Engineer's approval, prior to commencement of Post Installation inspection and testing.

21.4.3.6 During the inspection, it shall be verified that

- The equipment has been installed as per the procedures and designs and drawings that have been reviewed by the Engineer and that equipment is correctly located and labelled.
- Any false feed, temporary wiring and redundant items have been removed and that equipment is correctly protected against interference, damage and deterioration.
- The Contractor shall submit Installation Checklist of individual items/ equipment/subsystems based on the designs and submit it for Engineer's review at least 28 days before commencement of Installation.
- Contractor shall prepare **separate checklist** for EI, MSDAC, HASSDAC, BPAC, IPS, RDPM with data logger, Signals, Points machines, Cables, Location Boxes, earthing and bonding etc. not limited to Installation checklist issued by IR/RDSO/OEM, where available. The installation check list shall include Structure gauge checks to ensure the installations are carried out to the **Schedule of Dimensions requirements;**
- The Installation shall be inspected and witnessed by the Engineer's representative as per the Installation checklists and records shall be maintained. The defects noticed during inspection shall be appended to/ recorded on the Inspection checklists. Once the Contractor has rectified the defects, the same shall be informed to the Engineer with **photographs of rectification**. The same shall be verified by the Engineer and recorded. The Installation inspection records and Installation checklists shall form part of Installation test records.
- These tests shall make readiness for SAT to verify the correct operation of all apparatus and where appropriate, correct response to the respective control commands or monitored function.

21.4.3.7 After installation of the equipment, Visual inspection on un-energized equipment shall be carried out to check the following:

- Cleanliness;
- Workmanship;
- Confirmation of items conforming to ratings specified;
- Water and dust proofing;
- Levelling, mounting and positioning;
- Joints and connections tightness;
- Cables — dressing, bending radii, jointing and finish at terminals;
- Clearances and dimensions in conformity with drawings and SOD;
- Earthing and bonding;
- Layout and Equipment profile check.

- Protection devices;
- Painting
- Labeling
- Locks
- No breakages

21.4.3.8 The Visual inspection shall be followed by (but not limited to) further Installation tests as under:

- Voltage measurements;
- Continuity test as per wiring diagram;
- Cable Insulation testing;
- Power cubicle function test;
- Wire continuity tests;
- Earth value measurements;
- Wire count tests;
- Software is correctly installed with the correct version and checksum;
- Circuit board is of correct version and is correctly installed;
- Strap and Function tests;
- Through circuit function test of the equipment;
- Signal Sighting tests;
- Functioning of circuit breakers, isolating switches and their interlocks;
- Interface tests with other equipment.
- Simulation test if applicable.

21.5 SYSTEM ACCEPTANCE TEST

21.5.1 Once the Installation tests on individual items/equipment/subsystems are complete and they are interconnected and configured to form a complete system, the System Acceptance Test is carried out to ascertain that all the equipment supplied under this Contract satisfy the functional and specified performance requirements in all respects.

21.5.2 System Acceptance Tests shall comprise of comprehensive testing of the completely assembled installation to ensure that every item has been installed and adjusted and that all systems operate in every respect in accordance with the requirements of the specification and are ready for integrated testing and commissioning

21.5.3 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.

21.5.4 Prerequisites for commencement of the System Acceptance Tests (SAT):

21.5.4.1 All documentation for the System Safety report have been submitted to theEngineer for review;

21.5.4.2 All Installation Tests have been completed and test records submitted to the Engineer for review;

21.5.4.3 Facilities for the maintenance of the system are in place;

21.5.4.4 Non interlocked working as per **Appendix-4(NI)** of this document at IR stations namely Patli shall be required to be undertaken by the contractor to perform SAT and final commissioning of stations. In this connection all IR Railway Board instructions on commissioning of RRI/PI/EI and Non interlocked working for commissioning of signalling works shall be followed as **Appendix-4 (NI working).**

21.5.4.5 The SAT Plan has been submitted to the Engineer for review at least **ninety (90) days before** the commencement of the SAT. This test shall include functional test of all Signaling equipment from the control equipment in SM room. This test includes but not limited to:

- EI test as per approved selection table
- Point operation & Correspondence
- Signal aspect correspondence
- Conflicting route testing
- Any unusual operation
- Emergency operation
- Track detection as per approved SIP
- Block instrument testing
- Any other equipment as per PS Signaling.

21.5.4.6 Verification and Validation of Application logic

- The FAT tested Application logic shall be loaded in the installed EI and verified to see that it meets the requirement of the Control table.
- Tests shall be carried out on each Signalling function to ensure that all the controls specified in the Control tables are present and effective.
- It is permissible for the application logic to be verified by use of application tool/ simulation systems. The extent of verification testing by application tool/ simulation shall be defined in the Test plan.
- Where a control is required to be in the Application logic but is not possible to test, this shall be stated in the test specification, together with any alternative testing to be performed to mitigate any reasonably foreseeable hazard.

21.5.4.7 Functions commonly requiring to be tested include, but are not limited to:

- EI Hot standby tests;

- Route initiation and setting;
- Approach locking;
- Point interlocking;
- Route interlocking;
- Sectional and sequential route releasing;
- Train operated route release;
- Block controls;
- Emergency cancellations;
- Crank handle interlocking;
- Aspect sequence.
- Interfacing with other sub systems like Track detection system, BPAC etc.
- Verification shall demonstrate that correct correspondence exists between all commands, controls, status detecting mechanisms and their indications, both within the integrated system and to any external interfaces.
- Validation of Application logic involves testing of the Application logic in accordance with the requirements of the relevant safety case and product application requirements. The validation activities shall be defined in the test specification.

21.6 INTEGRATED TESTING AND COMMISSIONING

21.6.1 The Contractor shall carry out Integrated Testing and Commissioning after the completion of the System Acceptance Tests. This test shall include the test of equipment from the IMD/ Control Centre of the project.

21.6.2 Integrated Testing on Completion shall include the Work of other contractor(s) also. 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.

21.6.3 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.

21.6.4 Non interlocked working as per **Appendix – 4 (NI)** of this document at IR stations namely Patli shall be required to be undertaken by the contractor to perform SAT and final commissioning of stations. In this connection all IR instructions on commissioning of RRI/PI/EI and Non interlocked working as per **Appendix-4 (NI)** for commissioning of signalling works shall be followed.

21.6.5 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.

21.6.6 Integrated testing and commissioning shall include the integration of the HORC section with the adjacent already commissioned sections, without disturbing the safety and revenue operation of the earlier commissioned sections.

21.6.7 Conducting of these Integrated Tests by the Contractor and the other contractors shall include a period of Trial Run.

21.6.8 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.

21.6.9 The results of the Integrated Testing and Commissioning shall be documented.

21.6.10 If any Signalling equipment/ sub system fails to pass Integrated Testing and Commissioning, the Contractor shall carry out at his own cost the necessary adjustment or modification to the equipment/ sub system required to satisfy the requirements of Integrated Testing and Commissioning within such time as the Engineer may deem fit.

21.7 TRIAL RUNS

21.7.1 On completion of SAT and Integrated testing and commissioning to the satisfaction of the Engineer, the Contractor shall confirm in writing to the Engineer that the works provided by him under the contract is ready for the Trial runs.

21.7.2 During the Trial run, the Employer will run the actual trains. The objective is to check that the functions and operations of the various systems are satisfactorily integrated and to allow all technical systems to settle and operating staff to become conversant with the working procedures.

21.7.3 The Trial run shall be made use for ensuring the following:

- Signal and indicators Sighting — approach sighting, focus, alignment, relationship with other signals, and interference from other sources of light (e.g. street lamps etc);
- Track Vacancy detection system operates correctly, reliably and continuously during presence/absence of a train; and
- Dynamic interfaces — Integrity of operation and indications across boundaries between different types of track vacancy detection equipment and between different interlocking;
- Specific types Signalling equipment could require a test train, especially where evidence of the correct operation of train /Signalling equipment interfaces is required; and
- Verify the layout to the Signalling plan.
- BPAC system operates correctly, safely, reliably and continuously during presence/ absence of a train;

21.7.4 The Engineer may issue instructions to the Contractor for particular works or actions required of him during this period. In addition, the contractor shall make good all defects and complete all outstanding works within the Trial period so as to permit the

commencement of revenue operations.

21.7.5 The Contractor's personnel shall be available throughout the period of Trial run.

21.7.6 After the successful Trial Run and after obtaining statutory clearances/approvals from CRS and or other relevant authorities, the Works shall be commissioned with the consent of the Engineer.

21.8 STATUTORY CLEARANCES

21.8.1 The Contractor shall obtain all the mandatory clearances required for commissioning of Signalling work. In such case, the Employer shall extend all the requisite help and assistance to enable inspection, tests, verification of test records and trial run by CRS.

21.8.2 The CRS sanction, if required will be applied for by the Employer. The Contractor will, however be responsible for preparation of all supporting documents required for CRS sanction.

(End of Chapter-21)

CHAPTER 22: SPARES, SPECIAL TOOLS AND TEST EQUIPMENT

22.1 GENERAL

22.1.1 The Contractor shall provide Spares/ Spare parts generally in accordance with the principles as given below. All Spare parts for which the Contractor has been authorized to provide through a written instruction by the Engineer shall be provided **six weeks** before commencement of train operations.

22.1.2 Coding and Tagging of Spare Parts and Special Tools and Test Equipment shall be done.

22.1.3 All Spares/Spare Parts and Special Tools and Test Equipment to be delivered to the Employer shall each carry a tag suitably marked, bar-coded (as directed by the Engineer) and numbered.

22.1.4 The numbers on the tags shall correspond with those on the coding system developed by the Contractor for all Signalling components, Parts and Equipment.

22.2 SUPPLY OF SPARES

22.2.1 The Spares/ Spare Parts to be supplied by the Contractor shall consist of:

- Commissioning Spares (as hereinafter defined);
- Defects Liability Spares (as hereinafter defined); and
- Contract Spares (as hereinafter defined).

22.2.2 Commissioning Spares

22.2.2.1 The Contractor shall keep on the Site throughout the installation, erection and commissioning periods, sufficient stocks of Spare Parts ("Commissioning Spares") to enable immediate replacement of any item in the Permanent Works found to be defective or in any way in non-conformance with the Specification during the installation, erection and commissioning period.

22.2.2.2 The Contractor shall submit the **list of 'Commissioning Spares',** with the types and quantities of Spares the Contractor intends to hold, at least **three (3) months before** the commencement of the installation activity, to the Engineer for review.

22.2.2.3 The Contractor shall ensure **availability of 'Commissioning Spares'** on or before the commencement of any System Acceptance Tests (SAT).

22.2.3 Defects Liability Spares

22.2.3.1 The Contractor shall keep sufficient stocks of Spares/ Spare Parts in an Off-site location in their site office throughout the Defects Notification Period to enable rapid replacement of any item in the Permanent Works found to require replacement as part of the Contractor's obligations during the Defects Liability Period ("Defects Liability Spares").

22.2.3.2 The Contractor shall submit the **list of 'Defects Liability Spares',** with the types and quantities of Spares the Contractor intends to hold, at least **six (6) months** before the commencement of the Defects notification period (DNP), to the Engineer for review.

22.2.3.3 The Contractor shall ensure **availability of 'Defects Liability Spares'** on or before the commencement of the DNP.

22.2.4 When the Contractor submits the list of 'Commissioning Spares' and 'Defects

Liability Spares' for Engineer's review, the Contractor shall provide calculation to support the proposed types and quantities taking into account the following:

- The expected failure rate of the parts.
- Population of the parts in the system.
- Criticality of the parts in the system.
- Availability and MTBF figures of the system.
- Spare delivery lead time.
- Workshop repair turnaround time.

22.2.5 The Contractor shall keep and maintain sufficient stock of his own 'Commissioning Spares' and 'Defects Liability Spares'. The Contractor will not be allowed to use the 'Contract Spares' for his Installation & Commissioning and Defects Liability needs.

22.2.6 The Contractor shall include details of the stock of 'Commissioning Spares' and 'Defects liability Spares' it holds, in the Monthly Progress Report. The Stocks shall include status of the Spares in the stores and under workshop repair.

22.2.7 Contract Spares

22.2.7.1 The Contractor's supply of 'Contract Spares' shall be for Employer's operation and maintenance need.

22.2.7.2 Following 'Contract Spares' shall be supplied:

S.No.	Item	Unit	Quantity
1	Underground cable	Km	10% of the total cable laid subject to a minimum of 1 km of each type.
2	All other Cable & wires, other than Underground cables	Meter	10% of the total cable/ wire used / laid subject to a minimum of 100 meter of each type.
4	Electronic Interlocking & Object Controllers — Control Terminal, Cards, Modules complete with interconnecting cables and connectors and all other associated accessories.	Number	20 % of each type installed subject tominimum of one.

5	BPAC, Digital axle counter — Cards, Modules complete with interconnecting cables and connectors and all other associated accessories.	Number	20 % of each type installed. Subjectto minimum of one card.
6	All rail mounted equipment complete with interconnecting cables and connectors and all other associated accessories.	Number	30% of each type installed. Subject tominimum of one.
7	VRLA/Other Batteries	Number	10% of each type installed. Subject tominimum of one.
8	Signals complete including Signal posts, Signal base Anchor bolts CLS units etc.	Number	5% of each type installed. Subject to minimum of one.
9	Integrated LED Signal Lighting Units complete with current regulator, interconnecting cables and connectors and all other associated accessories.	Number	20% of each type installed. Subject tominimum of one.
10	Point machines including ground connections	Number	15% of each type installed. Subject to minimum of one.
11	RDPM system including, Data loggers, data concentrators, HMU, CMU, FEP, LAN switch & other networking equipment (except Server) with interconnecting cables and connectors and all other associated accessories.	Number	15% of each type installed subject to minimum of one.
12	MCB, surge protection device, fuses & terminals	Number	15% of each type installed. Subject to minimum of one.
13	All other interconnecting cables/ connectors not	Number	10% of each type installed. Subject to minimum of 2 Nos.

	included above		
14	Other items/equipment/ material.	Number	10% of each type installed Subject to minimum 2 Nos.

22.2.7.3 List of spares with each IPS-

S.No.	Sub system	Spare components	Qty
1.	SMPS Charger Module	Module (as cold standby)	1 Module
2.	inverter Module	Module (as cold standby)	1 Module
3.	DC-DC Converter	DC-DC Converter for relay internal, relay external and block line	1 Module each
4.	Ferro-resonant type Automatic Voltage Regulator (AVR)	AC Capacitor	1 Set
5.	Fuses	All type of fuses used in IPS subsystem	1 Set
6.	Transformer	Module (as cold standby)	2 Modules
7.	Inverter/SMR	DC fan	2 Nos
8.	Cells	2V Cells	5 Nos

22.2.7.4 The Contractor shall submit **list and quantities** of each type of 'Contract Spares' at least **6 months before** start of 'Defect Notification Period', based on approved tentative BOQ which shall be adjusted on approval of As-Built BOQ. All spares quantities shall be rounded up to the nearest deliverable unit.

22.2.7.5 The List shall include information on make, model, rating, description, part number, drawing number, shelf life etc. of each item of 'Contract Spares'. The Contractor shall also identify the lead times for all the Spares/ Spare parts. Parts with long lead times shall be specially identified in the Spares list. In the event that any of the spares identified have a particular shelf life or storage requirement, this shall be made known to the Engineer with the submission of the Spares list, including the necessary action for disposal or storage.

22.2.7.6 The Spares/Spare Parts shall be manufactured at the same time as the Permanent.

22.2.7.7 **Works:** All Spare Parts shall be works tested and inspected in accordance with the

relevant quality system, suitably packed and labelled and delivered in accordance with this bidding document and GS (S&T). Test certificates for each piece or set of equipment shall be submitted to the Engineer.

22.2.7.8 Before the Spare Parts are delivered, the Contractor shall submit to the Engineer a shipment/ dispatch advice notifying details of shipment/transport such as date of dispatch, vessel/vehicle name, etc. as well as a packing list indicating the contract number, order number, the lot size, quantity and weight. The Spare Parts shall be consigned and delivered in accordance with the Engineer's instructions.

22.2.7.9 The Contractor shall **complete supply** of the 'Contract Spares' on or before start of Defects Notification Period.

22.2.7.10 The Contractor shall indicate the sources of supply of all 'Spares' and shall guarantee their availability during the design life of the project. For Spare Parts of consumable and high-use items, the Contractor shall ensure that a minimum of two alternative sources of supply are available.

22.2.7.11 Spare Parts shall be fully interchangeable with their corresponding part. All Spare Parts shall be configured to the latest revision during the Defects Notification Period.

22.3 SPECIAL TOOLS AND TEST & MEASURING EQUIPMENT

22.3.1 Following Tools & Test equipment but not limited to shall be supplied:

S.No.	Item	Unit	Quantity
1.	General purpose Signalling tool kit consisting of screw drivers of various sizes; flat pliers, nose pliers, cutting pliers, etc. of various sizes; 500 gm. hammer; cable knife,flat chisel of various sizes; brass brush; nylon brush; steel measuring tape,; adjustable screw wrench of various sizes; soldering iron 220V, 60 W; solder wire; tin cutter; flat spanner/ box spanner/ ring/ flat spanner of various sizes; continuity buzzer; AC/DC analog Multimeter 2 nos. of Philips or similar make; AC/DC digital Multimeter Fluke or similar make; Megger one each for 100 V & SOOV. All the tools shall be from reputed manufacturers and shall be supplied in a suitable carrying case.	Number	1
2.	Megger 500/100 V AC 0 to 200 M ohms with earth tester, electronic push button type of Philips or any other reputed make	Number	1

3.	Portable digital auto range Multimeter, Philips/ Fluke or similar make capable to measure from 0.1 mV / 0.01 mA AC/DC up to 10 Amp. AC/DC, 600 V AC/DC and resistance from 0.1 Ohms to 40 M Ohms complete.	Number	1
4.	Supply of heavy duty electric drill machine of size 31 mm 230V AC with hammering action complete capable of working on metal/ wood/ concrete complete with chuck and drill bits of various sizes for all three surfaces in a suitable carrying case from reputed manufacturers.	Number	1
5.	Supply of heavy duty electric drill machine of size 6 mm 230V AC with hammering action complete capable of working on metal/ wood/ concrete complete with chuck and drill bits of various sizes for all three surfaces in a suitable carrying case from reputed manufacturers.	Number	1
6.	Digital earth tester, 4 terminal, range 0-10/ 100 ohms with rechargeable battery complete with other required accessories in a suitable carrying case.	Number	1
7.	Portable Maintenance terminal (Laptop) for EI	Number	1
8.	Portable Maintenance terminal (Laptop) for MSDAC	Number	1
9.	Complete tool kit for maintenance of EI as per the recommendations of the manufacturer in a suitablecarrying case.	Number	1
10.	Complete tool kit for maintenance of HASSDAC as per the recommendations of the manufacturer in a suitable carrying case.	Number	1

11.	Complete tool kit for maintenance of MSDAC as per the recommendations of the manufacturer in a suitablecarrying case.	Num ber	1
12.	Complete tool kit for maintenance of IPS as per the recommendations of the manufacturer in a suitablecarrying case along with maintenance tool kit for VRLA batteries.	Num ber	1
13.	Computer based test set up with required software for automatic testing like 'Functional Testing' etc. of whole interlocking at a station.	Num ber	1
14.	Digital Cable route and fault Locator	Num ber	1

22.3.2 These Special Tools & Test equipment are for use by the Employer during normal operation & maintenance after taking over of the installations. None of the Special Tools and Test equipment provided for the Employer shall be used by the Contractor on site prior to delivery/during DNP/Maintenance period. The Contractor shall make his own arrangement of Special Tools and Test equipment for use during Installation, Defects Notification Period and Maintenance period.

22.3.3 The Contractor shall submit list and quantities of each type of 'Specials Tools and test Equipment' at least **6 months before** start of 'Defect Notification Period', based on approved tentative BOQ which shall be adjusted on approval of As-Built BOQ.

22.3.4 The List shall include information on make, model, rating, description, part number, drawing number, details of calibration etc. of each item of 'Special Tools and Test equipment'.

22.3.5 All Special Tools and Test Equipment shall be accompanied with drawings, schematics, assembly and connection drawings, circuit diagrams/descriptions, calibration instructions and Operation and Maintenance Manuals to enable them to be used by suitably skilled (but not necessarily specially trained) personnel in a non-hazardous manner and to achieve the desired result in terms of accuracy and quality.

22.3.6 The Contractor shall provide the means and instructions which describe the parameters of each item of Special Tools and Test Equipment that are critical to their proper methods of use and which enable the Employer's staff using the Special Tools and Test Equipment to achieve the proper performance and operation. Such means and instructions shall include, but not be limited to, any routine checking or re-calibration needs for the Special Tool and Test Equipment itself.

22.3.7 The Special Tools and Test Equipment (together with the relevant calibration certificates) required to carry out all the functions described in the Operation and Maintenance Manual shall be suitably packed and identified in accordance with GS (S & T) consigned and delivered in accordance with the Engineer's instructions. The extent of supply shall

include protective carrying cases as may be appropriate for the storage and use of each item. The supply of all 'Special Tools and Test equipment' shall be completed before the start of DNP.

22.3.8 The Contractor shall indicate the sources of supply of all 'Special Tools and Test equipment' and shall guarantee their availability during the design life of the project.

22.3.9 At any stage if the Employer feels that the 'Contract Spares' and 'Special Tools and Test equipment' being procured are less, then it reserves the right to order additional quantities before expiry of Defects Notification Period, as a Variation to the Contract Price at an agreed Price. Computer based inventory management plan for 'Spares' and 'Special Tools & Test equipment' shall be established by the Contractor for use of the Employer.

(End of Chapter-22)

CHAPTER 23: DEFINITIONS

1. 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.
2. Auxiliary/Subsidiary signals: Shunt signals — Independent or below Main signals, Calling-on signals, Route indicators.
3. Control Terminal: An Industrial grade computer complete with hard disc, VDU display monitor, key board and mouse, provided with SM.
4. Design life: The design life is the period of time during which the system is expected to work satisfactorily within its specified parameters.
5. Failure: A failure is an event which causes loss of function or performance within any part of the Signalling & Telecommunication System and requires a maintenance intervention to restore full functionality and performance.
6. 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.
7. Fouling Point: The position at the convergence of two tracks where the kinematic envelopes, one on each line, would come into contact.
8. Graceful Degradation: The transfer in quality or performance from the initial level to a lower operable level.
9. Headway: Minimum time interval between successive trains at any point on the line such that the speed of a train is not reduced by presence of any other train ahead.
10. Independence: The isolation between the investigating technician undertaking the work and a second person for example, responsible for checking or approving the work.
11. Main running signals: Home signal, Starter signal, Intermediate Starter signal, Advance Starter signal.
12. 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.
13. Mean Time Between Failures (MTBF): The average time between failures causing service delays for a piece of equipment, a system or a subsystem.
14. Mean Time to Repair/ Restore (MTTR): The average time being required to repair a piece of equipment, system or subsystem to restore to its proper working conditions.
15. Reliability: The probability that an item/equipment/system can perform a required function under given conditions for a given time interval.
16. Running Lines: The HORC Running lines between New Prithla (excluding) and New Harsan Kalan (excluding) Stations via Manesar, Kharkhoda along with all connecting lines to IR/DFC connecting stations.
17. Safety: Freedom from unacceptable risk.
18. Sub system: Each system comprising Signalling system. E.g. Distributed architecture with object controllers of EI sub system.

19. Supervisory Track Section: A Section of track between two DPs completely covering more than one track sections. Supervisory Track Section is used to automatically reset Track Sections under its jurisdiction.
20. Traffic Controller; The person deputed to control and regulate working of traffic on specified section of the railway provided with a system of speech communication.
21. Track Section: A Section of track between two DPs used for controlling the signal depending upon its clearance or otherwise
22. Video wall: A graphical representation of the railway and its global operating status.
23. Vital Relay : The relays associated with each track section & Supervisory track section. The status of vital relays indicate the clearance or otherwise of associated track section /Supervisory track section.
24. Wrong side Failure: A failure of a safety-critical system or subsystem which directly leads to a situation with the potential to cause harm, human injury, damage to property, plant or equipment, damage to the environment, or economic loss.

(End of Chapter-23)

2.3.2 SIGNALING & TELECOMMUNICATION WORKS

1. Provision of Route setting type centralised operation of points and signals with EI*/RRI* at all stations involved with yard remodeling in connection with double line between Salka Road - Khongsara & Khodri - Anuppur on Bilaspur Division of South East Central Railway.
2. Supply, Installation, wiring, programming, testing of Electronic Interlocking by the RDSO approved manufacturer, provision of motor operated points, D.C. tracks circuits,*MSDAC*/HASSDAC/SSDAC and MACLS, Indoor and Outdoor Modifications related with conversion from Single line to double line.
3. Provision of interlocking of level crossing gates located in station section along with commissioning by means of Panel & VDU/ Two VDUs *at* stations.
4. Provision of Block Proving by Digital axle counters and interlocking of mid section LC gates as per requirement an*d* approved Signal Interlocking Plans.
5. Designing and documentation including completion documents of signaling drawings for indoor and outdoor work.
6. Removal of S&T infringements or shifting of signaling gears like LC gates, location boxes, signals, cables etc. and telecom gears like cables, EC post etc. to facilitate the progress of earth work and bridge work for double line.
7. Supply and installation of signaling equipments viz. Electronic interlocking with wiring, operating cum indication panel, signal units and accessories, Integrated power supply equipments, Block Working with axle counter, location boxes and accessories, track circuit equipments, point machines with ground connection, electric lifting barrier , data logger with networking etc.
8. Indoor work of programming and commissioning of electronic Interlocking, erection of Relay rack, CT rack, wiring of relays, testing and alterations in circuits, installation of power supply equipments & IPS, operating and indication panel, data logger and networking, axle counter, installation of DG sets, painting and lettering of all indoor gears, releasing of all indoor gears etc.
9. Outdoor work of trenching and laying of cables, foundation for signals, location boxes, etc. wiring of location boxes, signal units, points machines, track circuits, axle counter jointing of signaling cables, earthing, RE protection, erection of electrical lifting barrier, painting and lettering of all out door gears, releasing of all outdoor gears.
10. *Provision of Telecom facilities including Outdoor work of trenching and laying of Telecom cables (Six Quad /OFC), Jointing, Erection of Emergency Control Phone (ECP), Communication facilities for SP/SSP/TSS/SCADA etc.*
11. *Testing of all indoor equipments for functional/operational requirements and all outdoor equipments of signals, points, track circuits, LC gates etc and carrying out necessary adjustments and modifications in consultation with Engineer. Preparation of all documents related with testing and test reports.*
12. Provision of all *New* control and communication equipments *or* Shifting of all control and communication equipments in the new ASM room along with associated telecom work.

Inspection of S & T Work

2.4.6 **S &T work is required to be carried out in accordance with the IRS specification for RRI/PI (S/36/87) and conforming to RDSO Specifications No. RDSO/SPN/192/2005 for EI with latest amendments issued. The installation practices of all signaling gears should be as per the Signal Engg Manual Part I &II issued in September 2001 and to suit latest relevant correction slips. The work is required to be carried out in accordance with the RE manual for stations falling under 25 KV electrified traction. The execution is required to be carried as per standard specifications of RVNL. However, specifications, drawings and other details mentioned in BOQ or in special conditions, wherever applicable will prevail over the standard specifications.**

2.4.7 **The Signal & Telecom material to be supplied by the contractor as per RDSO Specifications/ Drawings will have to be procured from approved Vendors appearing in Vendor Directories of RDSO and to be supplied duly inspected by RDSO. Where there are not more than three Indian suppliers categorized as Approved Vendor for a particular item, developmental vendors can be considered for placement of bulk order without any quantity restrictions. (Ref RB letter no 2001/RS(G)/779/7Pt 2 dated 06.11.2018).**

In case where there are more than three Indian suppliers categorized as Approved Vendor for a particular item, total quantity to be ordered on developmental sources shall be limited upto 20% of NPQ as per Railway Board's letter no. 2001/RS(G)/779/7 Pt 2 dated 25.06.2018.

For procurement through RDSO Vendors for Developmental order, prior approval of RVNL's Engineer shall be obtained duly following conditions laid down in the aforementioned letters.

2.4.8 **The Signal & Telecom material to be supplied by the contractor as per TEC/DOT/BSNL specification will have to be procured form DOT/TEC approved firms. The inspection of such items will however be carried out by RDSO provided the value is more than value stipulated in inspection policy of RDSO.**

2.4.9 **In case the contractor is supplying imported equipments from approved manufacturer, then in addition to manufacture's test certificate, such equipments shall be inspected by RDSO.**

2.4.10 **Signal & Telecom items not inspected by RDSO/ RITES for any reason will be inspected by the Engineer / Authorised Representatives of RVNL. In case of any difficulty in inspection, RVNL may decide the authority of inspection, either by any other Govt. agency or by consignee. Whenever materials are inspected by Authorised Representatives of the RVNL/Engineer, the contractor will be required to furnish his or manufacturer's Guarantee Certificate.**

2.4.11 **The RVNL shall have full power to reject any material that it may consider to be defective or inferior in quality, workmanship, or otherwise not in accordance with the Specification and the RVNL's decision shall be final, even though they might have been inspected by RDSO/RITES. The contractor shall remove forthwith any such material rejected and replace them promptly at his own cost. Inspected and accepted material, if damaged during transit shall be replaced by the contractor free of cost prior to installation.**

2.4.12 **Inspection Charges of RDSO and RITES will be borne by the Contractor.** ***In case of Change of Inspection from RDSO/RITES to RVNL/Consignee,1% of cost of material to be deducted by RVNL ,as Inspection Charges.***

2.4.13 **Items included in the list of items to be inspected by RDSO & RITES and are not inspected by RDSO/RITES for any reason whatsoever and will be inspected by the Authorized Representatives of RVNL. The following conditions will apply:**

i) Material conforming to RDSO specn/drg is procured from RDSO approved source.

ii) Contractor shall submit Manufacturer's Guarantee Certificate for the material.

iii) All such cases where change in agency of inspection other than mentioned in the schedule is required will be processed for specific approval of competent authority.

Appendix-1 to Section 5-2 PS (Signalling)

Type test for Signalling items

In case Employer is fully satisfied with the consolidated report of the assessment, approval shall be given for type testing of prototype sample.

The type testing of prototype sample shall be undertaken to the satisfaction of Employer. For the product having valid RDSO/ TEC approved type test shall not be taken.

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.

The following tests shall constitute type tests :

Visual inspection tests
Insulation resistance tests
Card level functional and fail safety tests
System level functional and fail safety tests
Computerized testing
EMI/EMC tests
Environmental / Climatic Tests
System Diagnostic Tests
System Software Test
Any other test deemed necessary

Manufacturer shall submit a comprehensive type test plan including procedure, type test format and expected results. The type test plan shall be finalized in consultation with Employer / ISA / Engineer.
Type tests shall be carried out at manufacturer's premises. Necessary testing equipment and competent man power shall be made available by the manufacturer.
Type test shall be carried out by Employer representative / ISA.
Tests which cannot be carried out in house may be referred to independent test house of repute.
EMC / EMI tests may not be required if previous independent witness tests have been successfully carried out and reported by document.

Field trials for Signalling items

The field trials shall be conducted to the satisfaction of the Employer.
The field trials shall be held on Indian Railways / HORC as decided by Employer. Employer shall coordinate with IR for this purpose.
The Contractor / Manufacturer shall make all arrangements for conducting field trials. This shall include; but not limited to; supply, installation, commissioning and monitoring of the equipment.
The trials shall be monitored in the following manner —

S N	Name of Division/ Railway / Section	Name of station	Equipment Model and version no.	Date of installation	No. of failures*	Remarks

* Analysis of cause of failures to be attached.Duration of field trial

SN	Item / Equipment	Initial trial	
		Number of equipment	Duration
1.	EI	01	180 days in parallel and/or standalone mode or a combination thereof as decided by Employer.
2.	BPAC & DAC	01	180 days in parallel and/or standalone mode or a combination thereof as decided by Employer

NOTE:

The number of equipment and duration can be suitably revised, as required, by Employer.
Employer shall decide if field trials and type test can proceed simultaneously or not.

(End of Appendix 1)

Appendix- 2 to Section 5-2 PS (Signalling)

Policy Circular No. 02/16

NORTHERN RAILWAY

Head Quarter Office,Baroda House,New Delhi.
No. 256-Sig/O/SG/Pt-XV Dated- 22.08.2016

CSTE/Project, CSTE/Project-West, CSTE/Project-HQ, CSTE/Construction, Baroda House, New Delhi.

Sr.DSTEs,

Northern Railway,DRM office,
DLI, FZR, LKO,MB & UMB.

Sub- **Guidelines for Signalling Cables Laying on Northern Railway.**

Ref- i) RDSO's Letter No. STS/E/Cable Laying Practices dated 31.10.11 & 07/11.03.14
This office letter No. 256-SIG/O/SG/Pt-XII dated 01.12.2011.
ML's DO letter No. 2011/SIG/SF/1/Cable Laying dated 15.11.2011circulated vide this office letter No. 256-SIG/O/SG/Pt-XII dated 29.11.2011.
Railway Board's JPO/Telecom Circular No. 17/2013 issued vide Railway Board letter No. 2003/Tele/RCIL/1/Pt-IX dated 24.06.2013.

RDSO has issued guidelines on Signalling Cable laying under reference (i) & ML's D.O. letter No. 2011/SIG/SF/1/Cable Laying dated 15.11.2011 circulated vide this office letter No. 256-SIG/O/SG/Pt-XII dated 29.11.2011 under reference (iii)**.** Further, Railway Board has issued JPO/Telecom Circular No. 17/2013 (under reference iv) for undertaking digging work in the vicinity of underground Signalling, Electrical and Telecommunication Cables. These guidelines have been discussed and deliberated upon in the HQ office as per the requirement & existing practice of Cable laying on Northern Railway and accordingly, guidelines for Cable laying to be adopted on Northern Railway have been prepared.

The important items for Signal cable laying to be adopted on Northern Railway are as under :-

PI/RRI/EI installations with more than 100 routes :-

Duplicated Power cable arrangement shall be adopted for PI/RRI/EI installation having more than 100 routes for External circuits i.e. 24V DC/ 60V DC External for Track proving & Point detection, 110V AC for Track Feed Battery charger, External 24V DC for Axle Counter, BPAC etc. (Ref- Para No. 3.5.3 of RDSO guideline).

Laying of Signalling cable from Home to Home Signal for PI/RRI/EI installations having more than 100 routes shall be done in RCC duct of 500mm width with removable top cover as per NR Drawing No. NR/Sig/Cable/002 & 003 (Annexure -9 & 10). Beyond Home Signal and upto Distant Signal, Normal trenching as per extant practice shall be continued. (Ref- Para No. 7.3.7 & 7.3.8 of RDSO guideline).

PI/RRI/EI installations with less than 100 routes :- For less than 100 route PI/RRI/EI installations, RCC ducting from Home to Home signal shall be adopted for works sanctioned prior to 2016-17 to the extent possible. Subsequently, from 2017-18 onwards all abstract estimate at PWP level should take care of full implementation of this guideline for all stations irrespective of number of routes. Beyond Home Signal and upto Distant Signal, Normal trenching as per extant practice shall be continued. (Ref- Para No. 7.3.7 & 7.3.8 of RDSO guideline).

Only in Automatic Signalling territory, between Advance Starter of one station and Home Signal of other station, RCC duct with 300mm width as per NR Drawing No. NR/Sig/Cable/001(Annexure -8) shall be adopted. (Ref- Para 7.3.8 of RDSO guideline). From 2017-18 onwards, all abstract estimate at PWP level should take care of full implementation

of this guideline.
In Para No. 7.3.11 of RDSO guideline, RCC duct is to be laid at the depth of 600mm to 1000mm. This para has been modified as "*The RCC duct shall be laid at the depth such that the top of RCC cover is at the depth of Minimum 690 mm below ground level."*
Laying cable in Solid & Rocky soil
In Para 7.4.1 of RDSO guidelines, following has been added as :

"However, before finalising tender schedule for Cable laying in solid/rocky soil area , detailed site survey should be conducted by min. Assistant level Officer, its report to be placed on record & approval taken from JAG level officer executing the work & accordingly quantity and depth of Cable laying in solid/rocky soil area to be finalised."
Para 7.4.3 has been modified as below:-
"In case, sharp edge of rocky ground cannot be prevented with sifted earth, GI pipe of medium grade of ISI mark as per IS: 1239 (Part-I) of suitable diameter shall be used. Diameter of GI pipe shall be decided by Engineer In-charge. Inspection of GI pipe shall be done by RITES. In isolated cases, Rocky ground can be given smooth surface by using either masonry bricks or cement concrete."
Sketch No. NR/SIG/Cable/004 showing Cable Laying in rocky area is enclosed (Annexure-11)
Track Crossing - DWC-HDPE pipe of suitable diameter as per RDSO specification RDSO/SPN/204/2011 shall be used as per NR drawing No. NR/Sig/cable/005 **(Annexure-12).** Diameter of DWC-HDPE pipe shall bedecided by Engineer In-charge. (Ref: Para 8.2 (iii) of RDSO guideline).Inspection of DWC-HDPE pipe shall be done by RITES.
Road Crossing :- GI pipe of medium grade of ISI mark as per IS: 1239 (Part-I) of suitable diameter shall be used. Diameter of GI pipe shall be decided by Engineer In-charge. Inspection of GI pipe shall be done by RITES **(NR drawing No. NR/Sig/cable/006 as Annexure-13, Ref: Para 9.1 of RDSO guideline).**
Cable laying on Bridges/Culverts –

For Cable laying on bridges/culverts with high flood level, reference Para 10.2 ofRDSO guideline, following shall be adopted:-
On approach of Bridges/Culverts, DWC- HDPE pipe of suitable diameter as per RDSO specification RDSO/SPN/204/2011 shall be used. Diameter of DWC-HDPE pipe shall be decided by Engineer In- charge.
On Bridge/Culvert portion, perforated GI pipe of medium grade of ISI mark as per IS:1239 (Part-I) of suitable diameter shall be used. Diameter of GI pipe shall be decided by Engineer In- charge.
At junction point of GI and DWC pipe, a GI bend of 112.5 degree, 1 mtr. Length as per IS 1239 (Part-2): 2011 and overlapping 250mm with DWC pipe shall be used.
Inspection of DWC-HDPE and GI pipe shall be done by RITES. A sketch No. NR/SIG/CABLE/007 showing cable laying on bridges/culverts with high flood level is enclosed **(Annexure-15)**.
Cable laying on Arch bridges :- For Cable laying on Arch bridges, reference Para 10.4 of RDSO guideline following shall be adopted :-
On approach of arch bridge, DWC- HDPE pipe of suitable diameter as per RDSO specification RDSO/SPN/204/2011 shall be used. Diameter of DWC- HDPE pipe shall be decided by Engineer In- charge.
On Bridge portion, perforated GI pipe of medium grade of ISI mark as per IS:1239 (Part-I) of suitable diameter shall be used. Diameter of GI pipe shall be decided by Engineer In- charge.
At junction point of GI and DWC pipe, a GI bend of 112.5 degree, 1 mtr. Length as per IS 1239 (Part-2): 2011 and overlapping 250mm with DWC pipe shall be used.

Inspection of DWC-HDPE and GI pipe shall be done by RITES. A sketch No. NR/SIG/CABLE/008 showing Cable laying on arch bridges is enclosed **(Annexure-18)**.
Cable laying on bridges/culvert with low flood level and metallic bridges shall be asper existing RDSO guidelines.

Planning for Cable route:- A new para 4.7 regarding Planning for cable routehas been incorporated. The details are as below:-

Para 4.7 : The cable trench should be as straight as possible. Cable Route Plan

should be immediately prepared after laying of the cable showing exact location of cables at an interval of every 30 - 40 meters also showing various protective measures provided like RCC duct, DWC pipe, GI pipe, GI trough etc. **After the submission of Cable route plan showing protective works, the payment to the contractor for complete trenching and Cable laying of the station to be released. This should be mentioned as special condition of the contract.**

12. **Laying of different type of cable in same trench** :- It is highlighted that for Laying of different type of cables in the same trench, para 7.2 of RDSO guideline to be followed strictly, particularly Signalling cables must be separated from power cables by a row of bricks between them as mentioned in Para 7.2.2. For this sketch No. SDO/CABLE LAYING/004 showing laying of signalling cable & Telecom/Power cable in same trench as enclosed **(Annexure-7)** should be ensured.

The detailed guidelines for Signal Cable laying (in 47 pages) to be adopted on Northern Railway are enclosed herewith. It is advised that these guidelines are circulated to all field executives to ensure its strict implementation in all future works.

This is issued with the approval of CSTE.

DA/ Guidelines in 47 pages
(Based on "Guideline on Signalling Cable laying" Version 1.1 issued by RDSO vide letter No. STS/E/Cable laying Practices, dated 07/11.03.2014)

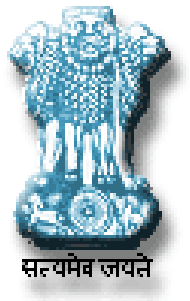
22.8.16

(V. K. Pandey)
Dy.C.S.T.E./P&D
for G.M./S&T

Copy to/-

1. **CSTE/CORE,** 1, Nawab Yusuf Road, Civil Lines, Allahabad for kind information & necessary action please.
2. **CMD/RVNL,** Plot No. 25, Ist Fir, B-Block, August Karanti Bhawan, Bhikaja Cama Place, New Delhi for kind information & necessary action please.
3. **CMD/DFCCIL,** 5th Floor, MRTS Building, Pragati Maidan, Metro Station, New Delhi for kind information & necessary action please.
4. **Chief Workshop Manager,** N. Railway, Ghaziabad for kind information please.
5. **Principal/STTC,** Ghaziabad for information please.

Appendix- 2
Appendix- 2



GUIDELINES

ON

SIGNALLING CABLE LAYING

TO BE FOLLOWED ON NORTHERN RAILWAY

Number of Pages - 47

(Based on "Guideline on Signalling Cable laying" Version 1.1 issued by RDSO vide letter No. 7STS/E/Cable laying Practices,dated 07/11.03.2014)

Appendix- 2

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Appendix- 2

Background

The Signal Engineering Manual (SEM) covers broadly various instructions on laying of signalling cables. Railway Board have also issued guidelines on the subject from time to time. This issue of cable laying practices has also been discussed in many forums like CSTE's Conference, MSG's etc.

On account of multiple faults in the cable and inadequate protection arrangement against short/open circuit faults, failures of point and other signalling gears have taken place on various Zonal Railways. In some of the cases, Railways signalling cables are invariably damaged by JCB & other track machine operated by Engineering Department, which resulted in serious dislocation to train services inviting criticism from different quarters.

Following documents are also considered while preparing this document:-

RDSO guideline on Signalling cable laying issued vide RDSO's Letter No.STS/E/Cable Laying Practices dtd 31.10.11 & 07/11.03.14.

Railway Board's Joint Procedure Order/Telecom Circular No. 17/2013 issuedvide Railway Board letter No. 2003/Tele/RCIL/1/Pt-IX dated 24.06.2013.

Cable Laying Practices adopted on WCR.

Railway Signalling Installation and Quality Handbook.

These guidelines on signalling cable laying containing consolidated instructions on the subject are being issued for uniform adoption on Northern Railways.

General

Railway signalling circuits shall normally be carried on cables. For new works, signalling circuits shall only be carried on cables. In 25 KV AC electrified areas overhead lines shall not be used.

Planning for cables

Cables used for carrying signalling, circuits shall conform to relevant approved specification. The conductors used shall be of annealed copper and of approved size. For this purpose, specification No. IRS:S 63 may be referred.

Power cable used for carrying power supply for signalling circuits shall conform to relevant approved specification. The size of conductor shall be so selected as to suit the electrical load. For this purpose, specification No. IRS:S 63 may be referred.

The Core-wise usage of signalling cable is as given below:-

Core & Cross section	RDSO Specification	Usage
6 Core × 1.5 mm^2	IRS S 63	Tail Cable
12 Core × 1.5 Sq. mm^2	IRS S 63	Tail Cable/LC Gate/ Main Cable
19 Core × 1.5 Sq. mm^2	IRS S 63	Main Cable
24 Core × 1.5 Sq. mm^2	IRS S 63	Main Cable
30 Core × 1.5 Sq. mm^2	IRS S 63	Main Cable
2 Core × 2.5 Sq. mm^2	IRS S 63	Track circuit lead connections
12 Core × 2.5 Sq. mm^2	IRS S 63	Main/Tail Cable
2 Core × 16 Sq. mm^2	IRS S 63 & IS 1554	Power cable
2 Core × 25 Sq. mm^2	IRS S 63 & IS 1554	Power cable
2 Core × 35 Sq. mm^2	IRS S 63 & IS 1554	Power cable
2 Core × 50 Sq. mm^2	IRS S 63 & IS 1554	Power cable
4/6 Quad Cable (0.9 mm)	IRS TC:30	Axle Counter

A cable core distribution plan is required to be prepared for each installation. Cables for power distribution shall be indicated for each signaling gear. A sketch No. SDO/CABLE LAYING/001 showing typical main cable distribution plan including power cable for field gears for a typical double line (4 lines) PI station is enclosed **(Annexure-4)**.

The distribution of various power supplies for operating signalling gear in yard shall be covered in cable distribution plan. However, following guidelines may be followed:-

In general, following power supplies are required to be distributed on each side of the station:-
110V AC for track feed battery charger etc.
24/60 DC for external for TPR, point detection etc.
24 DC external for electronic equipment like Axle Counter, BPAC etc.

The above power supplies as per the requirement of the station may be extended on each side of station and terminated at all main location boxes/huts.
Duplicated Power cable arrangement shall be adopted for PI/RRI/EI installation having more than 100 routes for External circuits i.e. 24V DC/ 60V DC External for Track proving & Point detection, 110V AC for Track Feed Battery charger, External 24V DC for Axle Counter, BPAC etc. to avoid major signalling breakdown affecting punctuality of train services during any damage/cable becoming faulty. A changeover switch may be provided at either end of the station for extending the alternate power supplyin case of failure.
In RE area, for automatic signalling, IBH, mid-section, level crossing gates and at station where location boxes/huts are more than 2 km power supply may be taken from auxiliary transformer.
In Non-RE area, for automatic signalling, IBH and mid-section level crossing gates, power supply may be extended from stations on either side. The arrangement shall be such that the power supply from one of station can be extended while at same time power supply from other station shall remain isolated.
While planning for cabling on a route, the number of conductors required, for the circuits shall be first determined. Recommended core sizes shall be used.
Adequate spare conductors to a minimum of 20% of the total conductors used shall be provided for in each main cable up to the farthest point zone, beyond this there shall be a minimum of 10% spare conductors of the total conductors used. The spare conductors shall be provided on the outermost layer. 2 numbers of 12 Core dedicated spare cable from home signal to home signal may be laid and terminated in all locations for instant transfer of these dedicated conductors in case of cable failure and cable testing.

Where a number of cables have been laid along a route, the circuits shall be so distributed that cables can be disconnected for maintenance purpose with theleast possible dislocation to traffic. Line wise and, if necessary; function wise cable shall be provided. Auxiliary signals shall be taken in different cables.
Separate cables of suitable size shall be laid for point operation.
Numbering of cable to be done in ascending order from right hand side of the cable core distribution plan.
Number of location boxes shall be kept at minimum. Where too many locations boxes (say more than 10) are coming in a close proximity generally between starter & home signal, it is proposed to use location huts instead of location boxes for security, proper protection and ease of maintenance.
Prefabricated huts (approximate size 10 feet x 10 feet) may be used, the drawing/design of which shall be issued by RDSO separately.

Planning for cable route

After deciding the size and the number of conductors in the different types of cables to be used on a route, a foot survey along the track shall be done to determine the best route for the cable.
The route shall be shown clearly on a cable route plan showing the actual alignment of track, giving offsets from permanent way or permanent structures. The diagram shall indicate the various road and track crossings, crossing with power cables, water and sewage mains and other points of importance. It is preferable to chart the route on a route plan on which the existing routes of power cables, etc. are shown. Changes, if any, shall be incorporated in the chart/plan.
While planning cable route plan, any future yard modification/doubling etc. shall also be kept in view.
Cable route plan shall also be approved by Engineering and Electrical Department. Cable route plan shall also be approved by Branch Officer of Signal & Telecom (Open Line) wherever it is prepared by organization other than open line.
As far as possible low lying areas, platform copings, drainages, hutments, rocky terrains, points and

crossings, shall be avoided.

Wherever JCB/Mechanized trenching or any kind of digging cases near existing cables is resorted, instructions contained in Railway Board Joint Procedure Order/Telecom Circular No. 17/2013 issued vide Railway Board letter No. 2003/Tele/RCIL/1/Pt-IX dated 24.06.2013 (Annexure-1) shall be followed.

The cable trench should be as straight as possible. Cable Route Plan should be immediately prepared after laying of the cable showing exact location of cables at an interval of every 30 - 40 meters also showing various protective measures provided like RCC duct, DWC pipe, GI pipe, GI trough etc. Afterthe submission of Cable route plan showing protective works, the payment to the contractor for complete trenching and Cable laying of the station to be released. This should be mentioned as special condition of the contract.

Laying of cable above ground

Signalling cables for outdoor circuits shall not normally be laid above ground.In exceptional cases where it becomes unavoidable, the following precautions shall be taken:-

The cable shall be suspended in wooden cleats, from cable hangers orin any other approved manner so that no mechanical damage occurs to the cable even under exposed condition.

The cable supports shall be so spaced as to avoid sag.

In station yards, cable shall be laid in ducts suitably protected.

Indoor signalling cable shall normally be laid on ladders, channels or in any other approved manner. The cables shall be neatly tied/laced.

In AC electrified areas cables shall be laid underground only. For laying cables in RE area instructions laid down in Chapter XXII of SEM shall also be followed. Extract of this chapter are available in para 22 of these guidelines.

Excavation and backfilling of the trenches

Manual trenching is recommended for laying of signalling cables in the station yards from Home to Home signal and mechanized trenching is recommended from Home to distant signal and beyond into block/automatic section.

Under road/platforms/railway tracks/difficult terrain etc., trench less horizontal directional drilling (HDD) method may be adopted under the supervision of competent staff for laying of GI/DWC-HDPE pipe. Both ends of GI/DWC-HDPE pipes shall be closed properly using accessories and the pits shall be properly backfilled. There shall be no damage to the road/platform/tracks or any such structures etc. enrooted during or after the HDD operations.

Excavation of cable trench shall be made in all kinds of soils including clearing roots of trees, rocks etc. Trenches shall be straight as far as possible and steep angles shall be avoided.

The bottom of the trench shall be levelled and got rid of any sharp materials. No sharp object like stone chips, iron pieces etc. shall ever come in contact with laid cables irrespective of the method of laying the same.

After cable has been laid and until the whole of the cables to be laid in the trench have been covered with their protective covers, no sharp metal tool such as spades, crowbar or fencing pins shall be used in the trench or placed in such a position that they may fall into the trench.

When cables are laid in trunking, care shall be taken to see that no ballast or stones have been dropped inside the trunking. The trunking shall be clearedof all ballast and stones before the cover is secured.

When the ends of covers are joined together with cement plaster, a piece of paper or wood shall be placed under the joint to prevent the cement plaster from falling on the cable.

It is desirable that the excavation of the trenches is not done in long lengths and does not remain uncovered for long period. It is preferable that cables are laid and refilling done on the same day.

Before commencement of the laying, inspection of the trench and inspection of protection works shall be carried out so as to ensure their conformity with the specification. A sketch No. SDO/CABLE LAYING/022 rule made of pipe for measuring depth is enclosed **(Annexure-25).**

Backfilling of the trenches shall be done properly. The earth excavated shall be put back on the trench, rammed and consolidated.

During excavation, the earth of the trenches shall not be thrown on the ballast. The earth shall be thrown by the side of the trenches away from the track.

Cable laying in underground

General

Cables may be laid underground, either in the trench, in ducts, in cementtroughs, in pipes or in any other approved manner.

Cables shall be laid generally as per instructions given in these guidelines. However, special precautions to be taken in the station yards etc. where a number of other utilities may be existing, may be detailed in a joint circular issued by the Civil Engineering, Signalling and Electrical Department (where applicable) of the Railway. Railways may provide any additional protection as necessary at a particular location due to prevailing law and order problem.

Cable is generally laid parallel to the track beyond Home signal with minimum deviations and on one side of the yard.

As far as possible, cable shall be crossed only at two locations, i.e. one crossing on each side of the yard.

The cable laid parallel to the track shall be buried at a depth of minimum 1.0 metre (top most cable) from ground level. A sketch No. SDO/CABLE LAYING/003 showing cable trench is enclosed **(Annexure-6)**. While those laid across the track must be minimum 1.0 metre below the rail flanges. However, in case of rocky soil, the depth may be reduced suitably. When it concerns the laying of tail cables which serve the track apparatus etc. the depth shall not be less than 0.50 metres. In theft prone areas the cables may be laid ata depth of 1.2 metres with anchoring at every 10 metres.

The width of manually made cable trenches shall commensurate with numberof cables. The minimum width shall be kept as 0.3 meters. The bottom of the cable trench shall be levelled and got rid of any sharp materials. In the soft ground, the cable shall be laid at the bottom of the trench previously levelled. In the rocky ground, the cable shall be laid on a layer of sand or sifted earth of 0.05 metre thickness previously deposited at the bottom of the trench. In both the above cases, the cable shall be covered with a layer of sand or sifted earth of 0.10 metre thickness and thereafter a protective cover of trough or a layer of bricks shall be placed.

Normally, not more than 12 cable are to be laid in one trench as it shall be difficult to attend failure at a later date. At a moderate size station with electrical signaling installation, generally the numbers of cable are more up to home, it is recommended that cables are laid in RCC duct up to home signalon both side of the station and may be extended up to distant, if required. This will also help later for laying of additional cable later without carrying out trenching.

While laying the cables in accordance with the above instructions, the following instructions shall be adhered to for the safety of the track:-

Outside the station limits, the cables shall generally be laid at not less than 5.5 metre from the centre of the nearest track.

Within the station limits, the trenches shall preferably be dug at a distance of not less than 3 metre from the centre of the track, width of the trench being outside the 3 metre distance.

At each end of the main cable an extra loop length of 6 to 8 metre shall be kept.

Extra loop length of the cable should also be buried at same depth as that of cable in the same trench and not projected outside to ensure that cable is free from theft/outside interference.

Before starting cabling work location boxes shall first be erected so that cable after laying is directly taken inside location box and its multiple handling/damage by re-digging and taking inside location box/Relay Room is eliminated.

A sketch No. SDO/CABLE LAYING/002 showing position of trenches for cable laying is enclosed **(Annexure-5).**

Laying of different type of cable in same trench

Where several cables of different categories have to be laid in the same trench, they shall be placed as far as possible in the following order starting from the main track side, so that in the event of failures, the maintenance staff may easily recognise the damaged cables:-

Telecommunication cable

Signalling cable

Power cable

A distance of approximately 10 cm must be maintained between telecommunication cable and

signalling cables. The signalling cables must be separated from power cables by a row of bricks between them.

A sketch No. SDO/CABLE LAYING/004 showing laying of signalling cable & Telecom/Power cable in same trench is enclosed **(Annexure-7)**.

Cable laying in ducts

RCC duct masonry or any other approved type of ducts may be used for laying the cable. The ducts shall have suitable covers and shall rest on walls of duct.

The ducts shall be of such design as to prevent water collecting in the duct.

After placing the trunking in the trench the ducts have to be aligned using 8 mm rod. For this purpose, a hole is left in the trunking for insertion of rods. Wherever there is a diversion proper care shall be taken to cover the cables, either by smoothly forming a curve with duct or a masonry structure can be constructed to protect the cables. After laying of cables the ducts shall be covered with RCC slab and shall be continuously plastered at the end with trunking.

When cables are laid in rocky area, it is desirable to protect them with split RCC ducts of suitable design.

Where it is necessary to take the cable between the tracks, it shall be carried in trunking kept sufficiently below the ballast level.

Cables for longer distances shall be laid on bottom layer. Duct shall be filled up with sand after cable is laid to avoid entry of rodents.

From Home to Home Signal, where number of signalling cables required are more, RCC duct of 500mm width with removable top cover shall be used for laying of Signalling cable for PI/RRI/EI installation having more than 100routes. Beyond Home Signal and upto Distant signal, Normal trenching as per extant practice to be continued.

Only in Automatic Signalling territory, between Advance Starter of one station and Home Signal of other station, RCC duct with 300mm width shall be used.

Partition of RCC duct for accommodating different types of signalling/telecom cables/ power cables may be provided, wherever required. This can be achieved by earmarking about 80% of inner space for multi core signalling/ telecom cables and the remaining 20% of space for carrying power cable more than 110V in a separate of chamber.

The RCC duct shall be laid at the depth such that the top of RCC cover is at the depth of Minimum 690 mm below ground level.

A sketch No. NR/Sig/Cable/001, 002 & 003 showing RCC duct is enclosed (Annexure-8, Annexure-9 & Annexure-10).

For jointing ends of RCC ducts precaution should be taken for proper alignment of RCC ducts, so that gap between two ducts is kept minimum.

Laying cable in solid & rocky soil

In case of rocky soil the depth may be reduced suitably. However, before finalising tender schedule for Cable laying in solid/rocky soil area , detailed site survey should be conducted by min. Assistant level Officer, its report tobe placed on record & approval taken from JAG level officer executing the work & accordingly quantity and depth of Cable laying in solid/rocky soil area to be finalised.

Sharp edges on the sides must be smoothened out and bottom of the chaseshall be leveled. In the rocky ground the cable shall be laid normally on layer of sifted earth of 0.05 metres thickness previously deposited at the bottom ofthe trench. Cable shall be covered with the layer of sand or sifted earth of 0.1 metre thickness.

In case, sharp edge of rocky ground cannot be prevented with sifted earth, GI pipe of medium grade of ISI mark as per IS: 1239 (Part-I) of suitable diameter shall be used. Diameter of GI pipe shall be decided by Engineer In-charge. Inspection of GI pipe shall be done by RITES. In isolated cases, Rocky ground can be given smooth surface by using either masonry bricks or cement concrete.

A row of bricks shall then be placed lengthwise on the top and jointed with cement mortar and a layer of concrete with cement plaster shall be provided on the top of the same. A sketch No. NR/Sig/Cable/004 showing laying of cables in rocky area is enclosed (Annexure-11).

Laying in special soil condition

Cable shall not be run through abnormally high acidic or alkaline soil or through sewages. If this is

unavoidable special measures shall be taken against corrosion. Cable may be laid in the Concrete/GI/CI/PVC/DWC-HDPE pipe properly jointed to prevent ingress of moisture.

Cable laying in residential area

When laying the cable in residential area, the cable shall be specially protected on both sides up to a distance of about 300 metres beyond the building line. In such cases, the cable shall be protected by means of concreting of 50 mm as proposed for rocky soil. This is better than using bricks as in a residential area bricks are usually found while digging and its special significance of cable protection may be overlooked.

Cable laying in large yard and suburban area

Main signalling cable in large yards including suburban section shall be laid in RCC ducts/DWC-HDPE pipes.

Tail cables shall be laid through DWC-HDPE pipes of suitable sizes and buried in trenches at a depth of not less than 1000 mm from ground level.

Track crossing

As far as possible, cable shall be crossed only at two locations, i.e. onecrossing on each side of the yard.

When a cable has to cross the track, is shall be ensured that-

The cable crosses the track at right angles;

The cable does not cross the track under points and crossings and

The cable shall be laid in DWC-HDPE pipes of suitable diameter as per RDSO specification RDSO/SPN/204/2011 shall be used. Diameter of DWC-HDPE pipe shall be decided by Engineer In-charge. Inspection of DWC – HDPE pipe shall be done by RITES.

Cable laid across the track must be 1.0 metre (minimum) below the rail flanges.

No digging shall be done below the sleepers. Digging work while crossinga track shall be done between sleepers in the presence of a Railways representative.

A sketch No. NR/Sig/Cable/005 showing track crossing is enclosed (Annexure-12).

Road Crossing

The cable shall be laid in GI pipe of medium grade of ISI mark as per IS: 1239 (Part-I) of suitable diameter at the depth of 1 metre from the ground level while crossing the road. It shall extend 1 metre (minimum) on each side of the road keeping in view the future increase of width of the road. Diameter of GI pipe shall be decided by Engineer In-charge. Inspection of GI pipe shall be done by RITES.

When crossing roads, it is necessary to lay the cables in such a manner as to avoid the necessity of bending the cable sharply and minimise the excavation of road surface as far as possible.

The crossing of main roads often involves difficulties, especially if traffic is heavy. Precautions to avoid accidents to workmen, pedestrians and vehicles shall be taken. On minor roads, which can be temporarily closed to traffic it is possible to open up across the entire width of the road, pipes shall be installed quickly in the cutting, which is then filled in there by reducing to a minimum the time for which the road is closed.

Some roads, which are broad, may be opened for half their width allowing the other half for use of traffic, pipes are laid, trench filled in the first half and the other half opened up after the first half is opened half is linked with those laid in the first half.

Whenever a cable is laid across an important road, particularly one with a special surface, it is good investment to provide for future expansion. Either the following methods may be adopted:-

The size of the pipe shall be so chosen that provision for laying few cable is future is kept in view. Pipes having diameters ranging from 100to 200 mm are suggested, or

A spare pipe may be laid, through which a cable can be drawn when required. It will be advantageous to leave a lead wire of G.I. wire in the pipe for drawing the cable in future.

A separate pipe of suitable dia shall be used for telecommunication cable.

A sketch No. NR/Sig/Cable/006 showing road crossing is enclosed (Annexure-13).

Cable laying on bridges/culverts

Wherever practical, the cable may be taken underground across the drain bedat a suitable depth for crossing small culverts with low flood level. A sketchNo. SDO/CABLE LAYING/011 showing cable

laying on culverts with low flood level is enclosed (Annexure-14).
Where cable may not be taken underground across the drain bed, cable shall be taken on the culvert following shall be adopted:-
On approach of Bridges/Culverts, DWC- HDPE pipe of suitable diameter as per RDSO specification RDSO/SPN/204/2011.
On Bridge/Culvert portion, perforated GI pipe of medium grade of ISI mark as per IS:1239 (Part-I) of suitable diameter shall be used. Diameter of GI pipe shall be decided by Engineer In- charge.
At junction point of GI and DWC pipe, a GI bend of 112.5 degree, 1 mtr. Length as per IS 1239 (Part-2): 2011 and overlapping 250mm with DWC pipe shall be used.
Inspection of DWC-HDPE and GI pipe shall be done by RITES. A sketch No. NR/Sig/Cable/007 showing cable laying on culverts with high flood level is enclosed (Annexure-15).
When cables have to cross a metallic bridge, they shall be placed inside a metallic trough. which may be filled, as an anti-theft measure, with sealing compound. The cable shall be supported across the bridge in a manner which would involve minimum vibrations to the cable and which will facilitate maintenance work. Adequate cable length to the extent of 2 to 3 meters shall be made available at the approaches of bridge. A sketch No. SDO/CABLE LAYING/013 & 014 showing cable laying on metallic bridges is enclosed **(Annexure-16 & Annexure-17)**.
For Cable laying on Arch bridges, following shall be adopted -
On approach of Arch bridge, DWC- HDPE pipe of suitable diameter as per RDSO specification RDSO/SPN/204/2011.
On Bridge/Culvert portion, perforated GI pipe of medium grade of ISI mark as per IS:1239 (Part-I) of suitable diameter shall be used. Diameter of GI pipe shall be decided by Engineer In- charge.
At junction point of GI and DWC pipe, a GI bend of 112.5 degree, 1 mtr. Length as per IS 1239 (Part-2): 2011 and overlapping 250mm with DWC pipe shall be used.
Inspection of DWC-HDPE and GI pipe shall be done by RITES. A sketch No. NR/Sig/Cable/008 & SDO/Cable Laying/016 showing cable laying on Arch bridges is enclosed **(Annexure-18 and Annexure- 19).**
Concreting of 50 mm shall be done throughout from entry/exit end of cable upto diversion point including slope on either side. The entry and exit ends of the cable from the pipe to the diversion point of the cable shall be concreted for 1 metre (minimum).
As the laying involves movement of a large number of staff over the bridge the line shall be blocked and flagman posted on other side. On a double line only the line near which the cable is being laid shall be blocked but care shallbe taken to see that staff are aware of this and measures taken to prevent staff from straying on to the unblocked line.
Damage to cable is likely to occur if care is not taken in laying cable where the bed changes from solid support such as a foundation, pier of bridge to soft support such as soft soil. The cable must not press against the edge of the solid support. The soft soil near the edge must be tamped and the cable raised slightly.
In order to prevent theft and miscreant activities on approach of cable to bridge/culvert where it is not possible to ensure adequate depth, concrete protection is proposed.

Laying near to sleeper

In places where cables are to be laid within 1 metre from sleeper end, digging beyond 0.50 metre shall be done in the presence of an official from Engineering Department, and the laying of the cable and refilling of trench shall be done with least delay. Laying may be undertaken under block protection as needed.

Jumper cables for track circuits

There are numerous instances of jumper cable cut due to Engineering staff working. Such instances can be minimized if jumper cable is tied with the nearest sleeper. This shall be done on wooden sleepers using iron clamps/hooks. On PSC sleepers jumper cable shall be tied using clamps. A sketch No. SDO/CABLE LAYING/017 showing arrangement of jumper cable is enclosed **(Annexure-20)**.

Where sleeper ends, cable shall be buried underground in the line of sleeper and taken to TLJB.
Wherever required, cable may be laid in DWC-HDPE pipe.
Jumper cable shall be laid at least 0.5 metre below ground level excluding ballast depth.
Jumper cable shall be laid neatly in squared manner and shall not be kept in loose coils above the ground near TLJB.
Top surface of TLJB shall not be 1 feet above rail level.

Cable markers

Cable markers wherever provided shall be placed at 30-40 metre interval andat diversion points.
There are three types of cable markers in use in different Zonal Railways:-
Cast iron Tablet type cable markers.
Concrete cable markers.
Electronic Markers
Concrete cable markers can be adopted where RCC ducts are used or area is prone to theft. Concrete markers are projected above surface level for at least 300 mm.
A sketch No. SDO/CABLE LAYING/018, 019 & 020 showing cable marker is enclosed **(Annexure-21, Annexure-22 & Annexure-23)**.

Storing & transportation of cable

Cable drums shall not be stacked on flat side. Suitable stoppers shall be placed for stability.
Cable drums shall have easy access for lifting and moving.
When rolling the cable drum either for unloading or transportation, the drum shall always be rotated in the direction of the 'arrow' which is marked on the drum.
The drums shall not be rolled over objects that could cause damage to the protective battens of the cable.
When unloading is carried out from the vehicle the drum shall not be dropped on the ground directly to avoid damage due to impact. Fork lifter or ramp shall be used.
During all stages of storage, it is essential that the ends of the cable are effectively sealed by end cap or in any other approved manner to avoid waterentry into the cable.
It is desirable that cable drums are stored in covered shed to protect against direct exposure to sun.

Paying out the cable

For paying out cables, the cable drums shall be mounted on cable wheels. It shall be ensured that no kink is formed while paying out the cable. A sketch No. SDO/CABLE LAYING/021 showing method of unrolling cable is enclosed **(Annexure-24)**.
The drum on the wheel shall be brought to one end of the trench and the endof the cable freed and the cable shall be laid along the trench.
The cable duct shall be brought as close to the cable trench if possible. The cable drum shall clear the ground by 5 to 10 cm.
The wooden battens on the drums shall be carefully removed shortly prior to laying and before the drum is mounted on the jack.
A party of labourers shall move along the trench carrying cable at suitable intervals so that cable is not damaged due to dragging along the ground or bent unduly.
The in-charge of cable laying shall ensure proper synchronization of all labourers for smooth laying.
In cases where the wheels are not available, the drum shall be mounted on an axle at one end of the trench and cable paid out and carried by labourers.
In no case, shall the drum be rolled off on to the road for laying the cable andthe cable dragged on the ground for laying purposes.
Whenever mechanized equipment is used, the work shall be carried out by a trained operator under the supervision of SSE/SE/JE (Signal) in-charge of the work.

Where the cable drum is in damaged condition the cable may be placed on a horizontal revolving platform and the cable paid out in the same manner as given in paras above.
Paying out of cable shall be done by rotating the cable drum and not by pulling the cable with excessive force.
Wherever flaking of cable is required, it shall be done by making a succession of loops in the form of Figure '8', these loops being disposed on top of each other to avoid tangling of cable. Figure of '8' flaking shall only be carried out under the direct supervision of an experienced official.

Laying in monsoon season

It is not advisable to lay cables in monsoon when the precipitation is heavy. The trenches will be inundated and visual inspection of the bedding of the trench will be rendered difficult. Threading the cable in pipes will also be more difficult.
When however cable laying is necessary during the monsoon season, the cable ends shall be inserted in a pipe sealed at one end and the pipe buried. Termination work shall be started only when there is likelihood of a clear weather for three or four days.
Entry of cable at cabin, relay room, location boxes etc.
All cable entry points in cabin, relay room, battery room, SM's room, location boxes, location huts, junction boxes, etc. must be closed with suitable masonry works, sand covered and plastering to prevent entry of rats etc. RCC slab shall be provided on the cable pit of cabin and relay room/station. Cable shall be protected on both sides up to a distance of 10 metre beyond building line of cabin, relay room, battery room, SM's room. In case of location boxes, location huts, junction boxes etc. cable may be protected for 1 metre on each side.
Damage to cable is likely to occur if care is not taken in laying cable where the bed changes from solid support such as a foundation/masonry to soft support such as soft soil. The cable must not press against the edge of the solid support. The soft soil near the edge must be tamped and the cable raised slightly.

Cable termination

The cable termination of signalling cables shall be undertaken by providing suitable location boxes/junction boxes on approved type termination.
All the core of the cable (used or spare) shall be terminated on approved type termination in cabin/SM's office or apparatus cases. Each core so terminated will be provided with identification ferrules with letters or/numbers embossed on them as per requirement of circuitry.
Termination of signalling cable on CT rack in relay room and in location boxes shall be done duly using identification marking on cable and on conductors/terminals. This will enable easy identification of conductors in case of any failures or cable disconnections or cable cut done by outsider/ miscreants. A proper marking and termination practice ensures quick and easy restoration during failures.
For quad cable, jointing may be done as per instructions of Telecom Directorate of RDSO. For jointing of signal cable in straight portionarrangement shall be issued by RDSO separately.

Testing of cable

Before the cable is laid in the trench, a visual inspection of cable shall be made to see that there is no damage to the cable. It shall be tested for insulation and continuity of the cores. Thereafter, the cable shall be laid into the trench. Record of insulation and loop resistant must be maintained.
Testing of all main and tail cables after laying of the cable in trenches and also after termination in apparatus cases, in boxes and relay room shall be done.
Any defect noticed during the testing after laying the cable the same will be replaced.
All conductors in signalling cables must be tested for their insulation in dry weather every year as per instructions in para 20 below. A comparison of the test results between successive tests carried on a cable under similar conditions will give an indication of the trend towards deterioration of the insulating

material over a period of time. If a sudden fall in insulation is observed, the cause shall be investigated and immediate steps taken up to repair or replace the cable.
In addition to the regular testing of cables in dry weather, random tests in wet weather may also be carried out, where considered necessary, to localise any sudden deterioration in insulation of cables.
After completion of any P.Way work in the vicinity of existing cable, testingof all cable may be undertaken to verify proper working of cable.

Instructions for insulation resistance testing of signalling cable

General

These instructions apply only to cables used for Railway Signalling and do not cover open line wires and internal wiring.
Insulation Resistance tests shall be made in such a manner that safe operationof trains is not affected. It shall be ensured that no unsafe conditions are set up by the application of test equipment.
All conductors in signalling cables must be tested for their insulation at the time of commissioning and thereafter in dry weather every year preferably during the same part of the year.
The insulation resistance tests shall be made when conductors, cables and insulated parts are clean and dry.
In addition to regular testing of the cables in dry weather, random tests in wet weather may also be carried out where considered necessary.
The conductors of the cables possess appreciable electrostatic capacity and may accumulate electrostatic charge. The cable conductors shall be shorted or earthed to completely discharge any accumulated charge (i) before connecting the insulation tester while commencing the test (ii) before the insulation testeris disconnected when the test is completed. This is in the interest of safety of personnel and protection of equipment
A 500V insulation tester shall be used for insulation testing. The fact that the cable has capacitance means that it has to be discharged before a measurement of the insulation resistance can be made.
The insulation resistance shall therefore be recorded after the test voltage has been applied for one minute or so when the indicator of the insulation tester shows a steady reading.
Any metallic sheath or metal work of any rack or apparatus case shall be bonded to earth during test.

Procedure

Disconnect all cores of a cable at both ends. The disconnection may be made through links of approved type terminals, if provided.
Connect one terminal of the insulation tester to the conductor under test and other terminal to all the other conductors being bunched together and connected to earth.
Similarly test remaining conductors of the cable one by one.
Insulation Resistance so measured shall not be less than 5 mega ohms per kilometer at buried temperature. If the insulation resistance is found to be lower than 5 mega ohms, the cause shall be investigated and immediate steps taken to repair or replace the cable to prevent any malfunctioning of the equipment and circuits.
The results of the insulation resistance tests shall be recorded in approved proforma. A comparison of test results between successive tests carried out on a cable under similar conditions will give an indication of the trend towards deterioration of the insulation resistance of the cable. If sudden fall in the insulation resistance is observed the cause shall be investigated and immediate steps taken to repair or replace the cable.
Supervision of cable laying
The work shall be supervised at site personally by an official of the Signal & Telecommunication Department not below the rank of a JE/SE/SSE (Signal).
Orders will be given by the Inspector in charge only. He will be assisted by others at vulnerable places to inform him of the position and possible danger.

Appendix- 2

All concerned staff shall have full knowledge of their duties and the material handled by them.
No work shall be started unless all types of materials, tools consumable materials and staff are available. Location boxes and junction boxes shall be in position. If the cable ends are left in the ground unattended, damage is likelyto take place.
Following record shall be maintained by JE/SE/SSE in-charge of the work/section:-
Cable route plan
Cable distribution chart
Cable termination diagram
Cable Testing Record : Summary Sheet, including supply details etc. as perAnnexure 2.
Cable Insulation Resistance Test Sheet as per Annexure 3.
Special requirements in 25 kV AC electrified area
Only unscreened cable shall be used.
Screened signalling cable may be used on signalling installations where screened cable is already in use and site condition demand its further use.
PVC insulated PVC sheathed and armoured unscreened cable to an approved specification (IRS-63) shall be used for carrying signalling circuits. Only approved type (IS-1554) power cable shall be used for signalling purposes.
The screened cable, if used, shall be PVC insulated, armored and to an approvedspecification IRS S-35.
The cable shall be so laid that it is not less than one meter from the nearest edge of the mast supporting the catenary or any other live conductor, provided the depth of the cable does not exceed 0.5 meters. When the cable is laid at a depth greater than 0.5 meters, a minimum distance of 3 meters between the cable and the nearest edge of the O.H.E structure shall be maintained. If it is difficult to maintain these distances, the cable shall be laid in concrete/heavy duty HDPE/Ducts or any other approved means for a distance of 3 meters on either side of the Mast. When so laid, the distance between the cable and the mast may be reduced to 0.5 meters. These precautions are necessary to avoid damage to the cable in the event of the failure of an overhead insulator.
In the vicinity of traction sub stations and feeding posts, the cable shall be at least one metre away from any metallic part of the O.H.E and other equipmentat the substation, which is fixed on the ground, and at least one metre away fromthe substation earthing. In addition, the cable shall be laid in concrete or heavy- duty HDPE pipes/or other approved means for a length of 300 meters on either side of the feeding point. As far as possible, the cable shall be laid on the sideof the track opposite to the feeding post.
In the vicinity of the switching stations, the cable shall be laid at least one metre away from any metallic body of the station, which is fixed in the ground, and at least 5 meters away from the station earthing. The distance of 5 meters can be reduced to one metre provided the cables are laid in concrete pipes/ heavy-duty HDPE pipes/ducts or any other approved means.
Where an independent Earth is provided for an OHE structure, i.e. where the mast is connected to a separate Earth instead of being connected to the rail, the cables shall be laid at least one metre away from the Earth.
Where there are O.H.E structures along the cable route, the cable trenches shall as far as possible, be dug not less than 5.5 meters away from the centre of the Track.
In a cable run, the number of circuits carrying 300V at any given instant shall not exceed three.
*Note: 300 V feed system shall not be used in future installations.
Drawings for cable laying
The sketches for cable laying in different areas, soils, bridges etc. are listed below and are enclosed. However, Railways may issue detailed drawings as per local requirement of Railways and number and size of cables required.

S.N.	Description	Drawing No.	Annexure
1.	TYPICAL MAIN CABLE DISTRIBUTION PLAN FOR DOUBLE LINE (4 LINES) PI STATION	SDO/CABLE LAYING/001	Annexure-4
2.	POSITION OF TRENCHES FOR CABLE LAYING	SDO/CABLE LAYING/002	Annexure-5
3.	CABLE TRENCH	SDO/CABLE LAYING/003	Annexure-6

Appendix- 2

4.	LAYING OF SIGNALLING CABLE & TELECOM/ POWER CABLE IN SAME TRENCH	SDO/CABLE LAYING/004	Annexure-7
5.	RCC DUCT 300 MM	NR/SIG/CABLE/001	Annexure-8
6.	RCC DUCT 500 MM	NR/SIG/CABLE/002	Annexure-9
7.	RCC DUCT 500 MM	NR/SIG/CABLE/003	Annexure-10
8.	LAYING OF CABLES IN ROCKY AREA	NR/SIG/CABLE/004	Annexure-11
9.	TRACK CROSSINGS	NR/SIG/CABLE/005	Annexure-12
10.	ROAD CROSSINGS	NR/SIG/CABLE/006	Annexure-13
11.	CABLE LAYING ON CULVERTS WITH LOW FLOOD LEVEL	SDO/CABLE LAYING/011	Annexure-14
12.	CABLE LAYING ON CULVERTS WITH HIGH FLOOD LEVEL	NR/SIG/CABLE/007	Annexure-15
13.	CABLE LAYING ON METALLIC BRIDGES	SDO/CABLE LAYING/013	Annexure-16
14.	CABLE TROUGH FOR METALLIC BRIDGES	SDO/CABLE LAYING/014	Annexure-17
15.	CABLE LAYING ON ARCH BRIDGES	NR/SIG/CABLE/008	Annexure-18
16.	BRICK MASONRY CHANNEL FOR ARCH BRIDGE	SDO/CABLE LAYING/016	Annexure-19
17.	ARRANGEMENT OF JUMPER CABLE	SDO/CABLE LAYING/017	Annexure-20
18.	CI CABLE MARKER & CONCRETING	SDO/CABLE LAYING/018	Annexure-21
19.	CI CABLE MARKER	SDO/CABLE LAYING/019	Annexure-22
20.	CONCRETE CABLE MARKER	SDO/CABLE LAYING/020	Annexure-23
21.	METHOD OF UNROLLING CABLE	SDO/CABLE LAYING/021	Annexure-24
22.	RULE MADE OF PIPE FOR MEASURING TRENCH DEPTH	SDO/CABLE LAYING/022	Annexure-25

Appendix- 2

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)
***

No.2003/Tele/RCIL/1 Pt.IX **New Delhi dated 24 .06.2013**

General Managers,
All Indian Railways.

Telecom Circular No. 17/ 2013

Sub: Procedure for undertaking digging work in the vicinity of Signaling, Electrical and Telecommunication Cable.

JPO No. 1/Sig/2004 dated 16.12.2004 issued by Board on the subject matter was reviewed in consultation with Signal, Electrical, Civil Engineering and Works Directorates of Board.

2. The same has now been finalized and a copy of the Revised Joint Procedure Order duly signed by ED/TD, EDCE/P, ED/SD, ED/W and EDEE/M is attached for compliance.

3. Please acknowledge receipt.

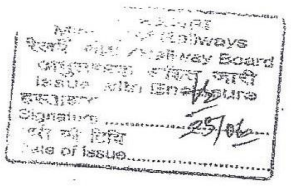
DA: 1 in 5 pages.

(Rakesh Ranjan)
Director(Telecom.

Copy to:-

i) ED/TD, EDCE/P, ED/SD, ED/W and EDEE/M
ii) CSTEs, All Indian Railways
iii) CSTEs/Construction, All Indian Railways
iv) ED/Tele, RDSO, Lucknow
v) MD/RCIL, 143, Institutional Area, Sector 44, Gurgaon – 122003.Haryana.

o/c



Annexure-1

Annexure to Telecommunication Circular No. 17 /2013

JOINT PROCEDURE ORDER FOR UNDERTAKING DIGGING WORK IN THE VICINITY OF UNDERGROUND SIGNALING, ELECTRICAL & TELECOMMUNICATION CABLES.

A. A number of Engineering works in connection with gauge conversion/doubling/third line are in progress on various Railways, which require extensive digging work near the running track, in close vicinity of the working S&T cables carrying vital safety circuits as well as electrical cables feeding the power supply to cabins, ASM room, RRI Cabin, Intermediate Block Huts (IBH) etc. Similarly, S&T organisation under open line or construction units under CAO/C, are executing various Signaling and Telecom works requiring digging of earth for laying of cables or casting of foundations for the erection of signal posts etc. RailTel is also executing the work of laying of quad cable and OFC on various Railways as a part of sanctioned works for exclusive use of Railways for carrying voice and data i.e. administrative and control communication, PRS, FOIS etc. or shared by RailTel Corporation of India Ltd. On certain sections digging is also required for laying of electrical cable and casting of foundation for the erection of OHE masts by Electrical Deptt. Generally, these works are executed by contractors employed by these organisations.

B. However, while carrying out these works in the vicinity of working signaling, telecommunication and electrical cables, at times, cable cuts take place due to JCB machines working along the track or during the digging work being done by contractors carrying out the Civil Engineering works. Similarly, such cable cuts are also resulting due to works undertaken by S&T or Electrical departments. Such cable faults results in the failure of vital signaling and telecommunication circuits & electrical installations.

C. Henceforth, the following joint procedure shall be followed by Engineering, Electrical and S&T (and RailTel organisation, wherever such works are being done by them) officers of the respective divisions and by the construction organisation, while carrying out any digging work near to existing signaling & telecommunication and electrical cables, so that the instances of cable cut due to execution of works, can be controlled and minimized.

1. S&T department (and RailTel, where they have laid the cables) and Electrical department shall provide a detailed cable route plan showing exact location of cable at an interval of 200 m or wherever there is change in alignment so that the same is located easily by the Engineering official/contractor. In addition, S&T department and Electrical department shall also provide cable markers along the alignment of the cable. These cable route plans shall be made available to the Sr.DEN/DEN or Dy.CE/C, as the case may be, by Sr. DSTE/DSTE or Sr.DEE/DEE of the divisions or Dy. CSTE/C or Dy. CEE/C within 15 days in

ED/TD EDC/D 1 of 5 ED/S D ED/W

duplicate. Sr. DEN/DEN or Dy.CE/C will send copies to their field unit i.e. AEN/SE/P. Way & Works.

2. Before taking up any digging activity on a particular work by any agency, Sr. DSTE/DSTE or Sr.DEE/DEE of the section shall be approached in writing by the concerned Engg. or S&T or Electrical officer for permitting to undertake the work. Sr.DSTE/DSTE or Sr.DEE/DEE, after ensuring that the concerned executing agencies including the contractor have fully understood the S&T and Electrical cable route plan, shall permit the work in writing within 7 days of the request by concerned department.

3. After getting the permission from S&T or Electrical department as the case may be, the relevant portion of the cable route plan shall be attached to the letter through which permission is issued to the contractor by concerned Engg. official for commencement of work and ensuring that the contractors have fully understood the cable route plan and precautions to be taken to prevent damage to the underground cables. The contractor shall be asked to study the cable plan and follow it meticulously to ensure that the safety of the cable is not endangered. Such a provision, including any penalty for default, should form part of agreement also. It is advisable that a suitable post of SE/Sig or SE/Tele or SE/Electrical(TRD or G) shall be created chargeable to the estimates of doubling/gauge conversion, who can help Engg. agencies in the execution of the work. However basic responsibility will be of the department executing the work and the contractor. Creation of posts is not mandatory.

4. The SE/P.Way or SE/Works shall pass on the information to the concerned SE/Sig. or SE/Tele or SE/Electrical(TRD or G) about the works being taken up by the contractors in their sections at least 3 days in advance of the day of the work. In addition Engineering control shall also be informed by SE/P.Way or SE/Works, who in turn shall pass on the information to the test room/network operation center of RailTel/TPC/Electrical control.

5. On receiving the above information, SE/Sig or SE/Tele or SE/Electrical(TRD or G) shall visit the site on or before the date of taking up the work and issue permission to the contractor to commence the work after checking that adequate precautions have been taken to avoid the damage to the cables. The permission shall be granted within 3 days of submission of such requests.

6. The name of the contractor, his contact telephone number, the nature of the work shall be notified in the Engineering control as soon as the concerned Engineering officials issue the letter authorizing commencement of work to the contractor. Test room shall be given copies. Test room shall collect any further details from the Engineering control and shall pass it on to S&T/RailTel & Electrical officials regularly. In case the supervisors of concerned departments do not turn up on the day as advised in terms of para 4 and 5 above, the works of contractor should not be stopped on this account.

ED/TD EDCE/P ED/W EDEE/M EDSD

7. In case of works being taken up by the State Government, National Highway Authority etc., the details of the permission given i.e. the nature of work, kilometer etc. be given to the Engineering control including the contact person's number so that the work can be done in a planned manner. The permission letter shall indicate the contact numbers of Test room/Network Operating Centre of RailTel/TPC/Elect. Control.

8. Where the nature of the work taken up by the Engineering department is such that the OFC or other S&T cables or Electrical cables is to be shifted and relocated, notice of minimum one week shall be given so that the Division/RailTel/Construction can plan the works properly for shifting. Such shifting works shall in addition, for security and integrity of the cables, be supervised by S&T supervisors/RailTel supervisors/Electrical supervisors.

9. The concerned SE/P.Way/SE/Works/SE/Sig/SE/Tele/ SE/Electrical(TRD or G) or RailTel supervisors supervising the work of the contractor shall ensure that the existing emergency sockets are not damaged in view of their importance in providing communication during accident/emergency.

10. In case of minor nature of works where shifting of cable is not required, in order to prevent damage to the cable, the Engineering contractor shall take out the S&T or optical fibre cable or Electrical cable carefully from the trench and place it properly alongside at a safe location before starting the earthwork under the supervision of SE/Sig. or SE/Tele or SE/Electrical(TRD or G). The cable shall be reburied soon after completion of excavation with proper care including placement of the brick over the cable under the supervision of S&T or Electrical supervisors. However, the work will be charged to the concerned engineering works. The responsibility for ensuring availability of SE (Signal), SE (Electrical) as per para 4 and 5 above lies with the respective department. The contractor will go ahead with the shifting of cables as per the program decided and he will not be held responsible for any cable cut.

11. In all the sections where major project are to be taken up/going on RailTel/S&T department shall deploy their official to take preventive/corrective action at site of work. As regards Electrical Department, the official may be deputed on need basis.

12. No new OFC or quad cable shall be laid close to the existing track. It shall be laid close to the Railway boundary on one side of the Railway track to the extent possible to avoid any interference with the future works (doubling etc.). It shall be ensured in the new works of cable laying that the cable route is properly identified with electronic or concrete markers. Wherever multiple cables are laid in a trench, RFID markers may be provided for easy identification of the cable. Henceforth, wherever cable laying is planned, before undertaking the cable laying work, the cable route plan of the same shall be prepared by the Dy.CSTE/C or Dy.CEE/C

ED/TD ED/CE/P ED/SD ED/W ED/EE/M

and shall be got approved from the concerned Sr. DSTE/DSTE or Sr. DEE/DEE and also from the concerned Dy. CE/C for new lines and from the concerned Sr.DEN for all other projects including doubling GC etc., to avoid possible damage in future. Such approval shall be granted within 15 days of the submission of the request.

13. The works of excavating the trench and laying of the cable should proceed in quick succession, leaving a minimum time between the two activities.

14. In case damage is caused to OFC/Quad cable [illegible] during execution of the work, the contractor is liable to pay a penalty for damaging the cable. Penalty shall not be levied in case of the following:-

   (i) Detailed cable route plan as per clause C-1 not provided by concerned department or cable is not protected as per laid down procedures.
   (ii) The alignment of the cable does not tally with the information provided to the contractor.
   (iii) The cable depth is found to be less than 800 mm from normal ground level.
   (iv) No representative of S&T department/RailTel was available at site guarding the cables on the fixed pre determined date and time.

15. Penalty to be imposed for damages to cable shall be as under:-

Cable damaged	Penalty per location
Only Quad cable or Signaling cable	₹ 1.0 Lakh
Only OFC	₹ 1.25 Lakh
Both OFC & Quad	₹ 1.5 Lakh
Electrical Cable	₹ 1.0 Lakh

Necessary debit in this regard shall be raised on the department undertaking the work who shall in turn levy the penalty on the defaulting contractor. S&T department shall raise the debits in case of damage to OFC or Quad or Signaling cable and Electrical department shall raise the debits in case of damage to Electrical cable.

16. Railways will not lodge FIR with RPF in cases of works being executed by authorized contractors of Railways who have been duly permitted to execute the works in accordance with this JPO. Joint note by the supervisors of the concerned department shall be prepared and the responsibility of the cable cut should be decided without involving RPF. The joint note deciding the fact whether the contractor should be penalized shall be completed in a day's time from the occurrence of cable cut.

In all other cases, when the cable is cut by an agency that was not permitted to execute any work, FIR should be lodged with RPF.

17. While giving permission for taking up the works, concerned departments may note that earthwork by engineering contractors will normally be done by machines except in a few isolated locations where the quantity of earth work is very less.

18. Railways shall make necessary correction in their future contract so that this JPO can also be enforced contractually.

19. In case of damage to OFC, RailTel should be paid 5/6th of the penalty recovered. RailTel shall raise demands on the S&T department in this regard.

20. All types of signaling & OHE bonds i.e. rail bond, cross bond and structure bond shall be restored by the contractor with a view to keep the rail voltage low to ensure safety of personnel.

21. Above joint circular shall be applicable for construction as well as open line organisation of Engineering, S&T & Electrical.

22. S&T cable and electrical cable route plan should be prepared by the concerned S&T and Electrical officers respectively and got approved as stipulated in para C-12 before undertaking the work. The completion cable route plan should be finalized block section by block section as soon as the work is completed.

23. All cable laying works shall be executed as per laid down technical specifications, such as protection measures/protective cover, compaction of refilled material etc.

(Rajeev Sharma)	(S K Saxena)	(Shobhan Chaudhuri)	(V P Dudeja)	(Surinder Pal)
Exec. Dir.	Exec. Dir.	Exec. Dir.	Exec. Dir.	Exec. Dir.
Signal Devel.	Elect. Enery (M)	Telecom (Dev)	Works	Civil Engg.(P)

Annexure-2

CABLE TESTING RECORD: SUMMARY SHEET

Cable No.		Cable Function	
Cable Size		Make	
Length		PO No. and date	
Between Locations		Inspection No. and Date	
Type of Protection		Spare Core Nos.	

SN	Date of Testing	Insulation Test Results		Ref. No. of Test Sheet*	Remarks and Signature
		Core to Core	Core to Earth		

*Tests sheets for Insulation and Loop resistance results in matrix format to be maintained separately for each cable in the cable testing register.

Annexure-3

CABLE INSULATION RESISTANCE TEST SHEET

Date of Meggering: **Signature**

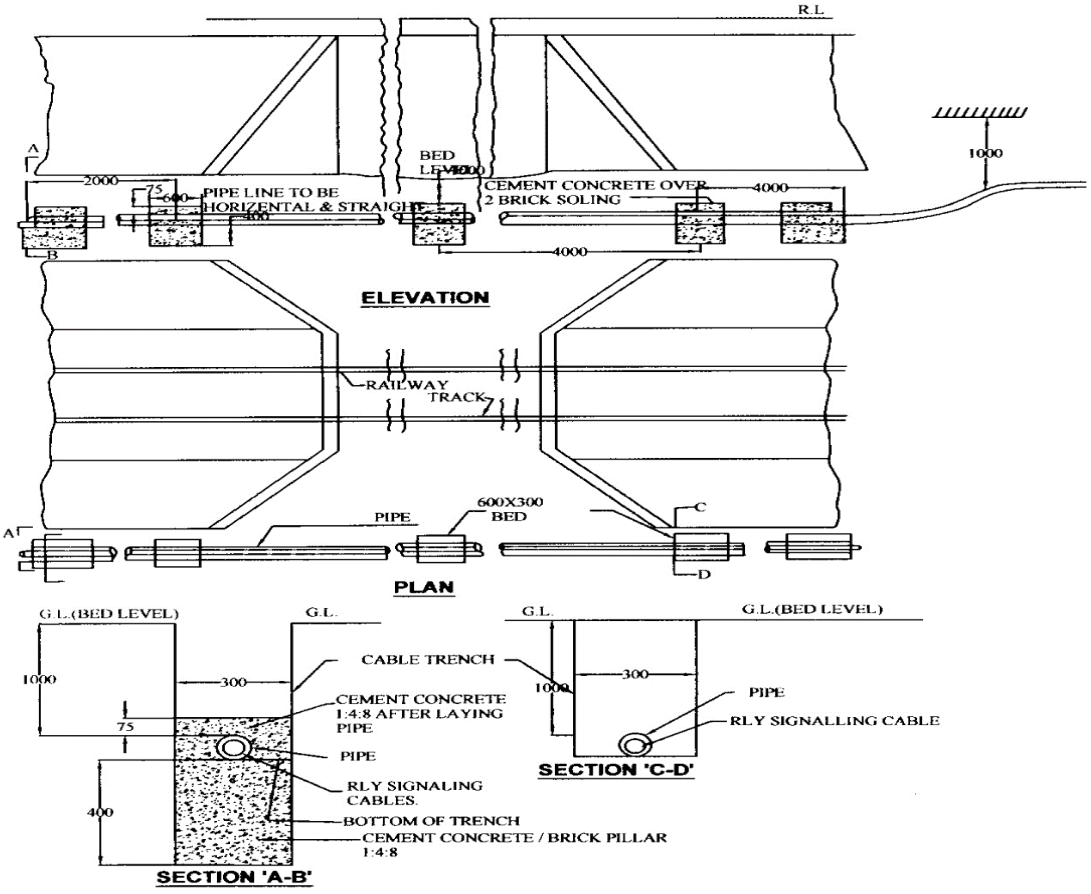
(All figures in mega ohms unless otherwise specified)

No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30E
1																														
2	1																													
3		2																												
4			3																											
5	1			4																										
6		2			5																									
7			3			6																								
8				4			7																							
9					5			8																						
10						6			9																					
11							7			10																				
12								8			11																			
13									9			12																		
14										10			13																	
15											11			14																
16												12			15															
17													13			16														
18														14			17													
19															15			18												
20																16			19											
21																	17			20										
22																		18			21									
23																			19			22								
24																				20			23							
25																					21			24						
26																						22			25					
27																							23			26				
28																								24			27			
29																									25			28		
30																										26			29	
																											27			30
																												28		
																													29	
																														30

(All figures in mega ohms unless otherwise specified)

Date of Meggering: **Signature**

Annexure-14

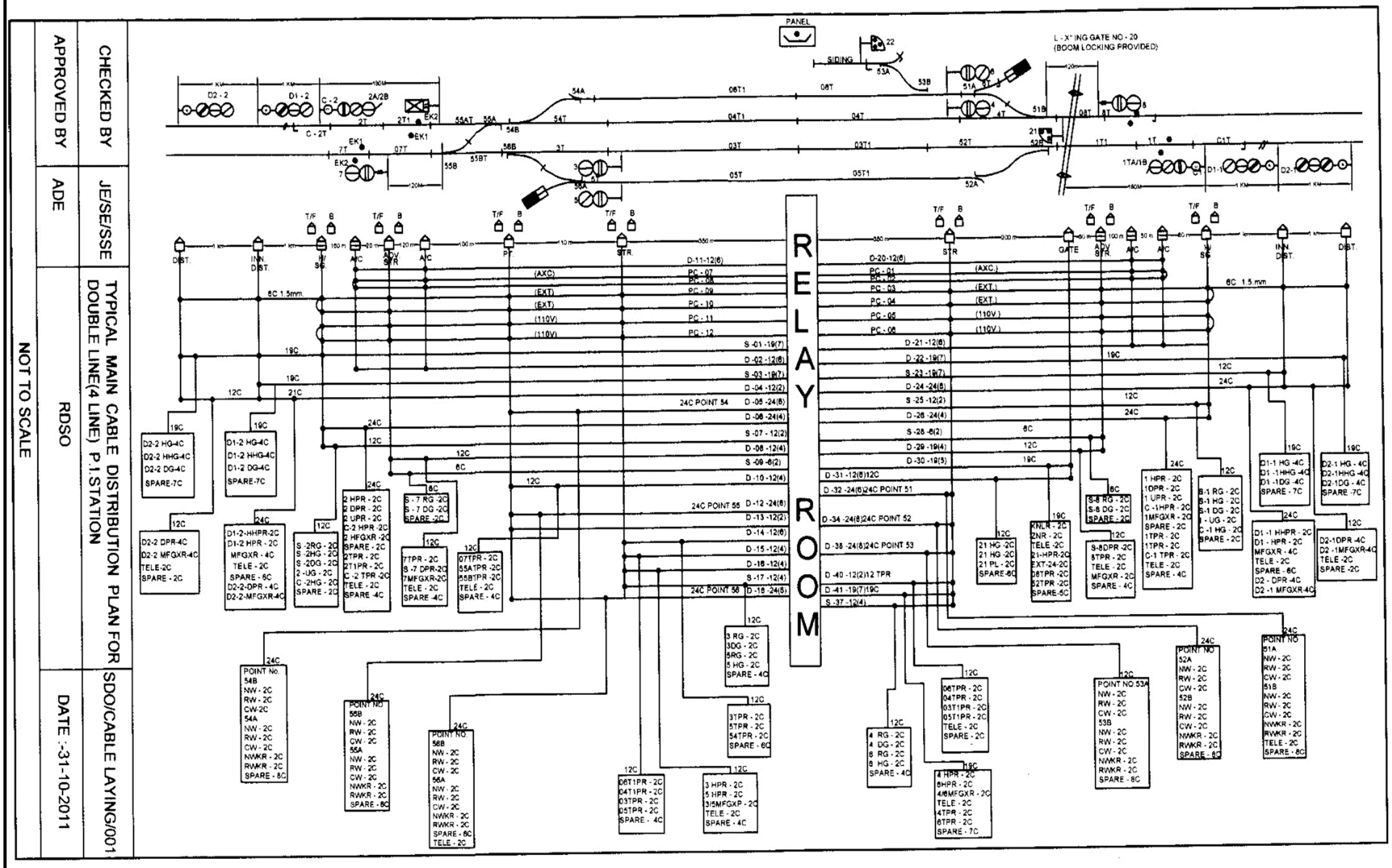


NOTE:-

ALL DIMENSIONS ARE IN MILLIMETER.

CHECKED BY	JE/SE/SSE	CABLE LAYING ON CULVERTS WITH LOW FLOOD LEVEL	SDO/CABLE LAYING/011
APPROVED BY	ADE	R.D.S.O	DATE :- 31-10-2011
NOT TO SCALE			

Annexure- 4


CHECKED BY
JE/SE/SSE
APPROVED BY
ADE
RDSO
TYPICAL MAIN CABLE DISTRIBUTION PLAN FOR DOUBLE LINE(4 LINE) P.I.STATION
SDO/CABLE LAYING/001
DATE :-31-10-2011
NOT TO SCALE
PANEL
SIDING
L - X ING GATE NO - 20
(BOOM LOCKING PROVIDED)
RELAY ROOM
D2 - 2
D1 - 2
C - 2
2A/2B
EK1
EK2
DIST.
INN. DIST.
H/ SIG.
A/C
ADV. STR.
PF
STR.
GATE
(AXC.)
(EXT.)
(110V.)
8C 1.5mm
19C
12C
24C
6C
D2-2 HG-4C
D2-2 HHG-4C
D2-2 DG-4C
SPARE-7C
D2-2 DPR-4C
D2-2 MFGXR-4C
TELE-2C
SPARE - 2C
D1-2 HG-4C
D1-2 HHG-4C
D1-2 DG-4C
SPARE-7C
D1-2-HHPR-2C
D1-2 HPR - 2C
MFGXR - 4C
TELE - 2C
SPARE - 6C
D2-2-DPR - 4C
D2-2-MFGXR-4C
2 HPR - 2C
2 DPR - 2C
2 UPR - 2C
C-2 HPR -2C
2 HFGXR -2C
SPARE - 2C
2TPR - 2C
2T1PR - 2C
C -2 TPR -2C
TELE - 2C
SPARE -4C
S -7 RG -2C
S -7 DG -2C
SPARE -2C
7TPR - 2C
S -7 DPR-2C
7MFGXR-2C
TELE - 2C
SPARE -4C
07TPR - 2C
55ATPR -2C
55BTPR -2C
TELE - 2C
SPARE - 4C
POINT No.
54B
NW - 2C
RW - 2C
CW-2C
54A
NW - 2C
RW - 2C
CW - 2C
NWKR - 2C
RWKR - 2C
SPARE - 8C
POINT NO.
55B
NW - 2C
RW - 2C
CW - 2C
55A
NW - 2C
RW - 2C
CW - 2C
NWKR - 2C
RWKR - 2C
SPARE - 8C
POINT NO.
56B
NW - 2C
RW - 2C
CW - 2C
56A
NW - 2C
RW - 2C
CW - 2C
NWKR - 2C
RWKR - 2C
SPARE - 6C
TELE - 2C
06T1PR - 2C
04T1PR - 2C
03TPR - 2C
05TPR - 2C
SPARE - 4C
3 HPR - 2C
5 HPR - 2C
3/5MFGXP - 2C
TELE - 2C
SPARE - 4C
3 RG - 2C
3DG - 2C
5RG - 2C
5 HG - 2C
SPARE - 4C
3TPR - 2C
5TPR - 2C
54TPR - 2C
SPARE - 6C
4 RG - 2C
4 DG - 2C
6 RG - 2C
6 HG - 2C
SPARE - 4C
06TPR - 2C
04TPR - 2C
03T1PR - 2C
05T1PR - 2C
TELE - 2C
SPARE - 2C
4 HPR - 2C
6HPR - 2C
4/6MFGXR - 2C
TELE - 2C
4TPR - 2C
6TPR - 2C
SPARE - 7C
21 HG -2C
21 HG -2C
21 PL - 2C
SPARE-6C
XNLR - 2C
ZNR - 2C
TELE -2C
21-HPR-2C
EXT-24-2C
06TPR -2C
02TPR -2C
SPARE-5C
S-8 RG - 2C
S-8 DG - 2C
SPARE - 2C
S-8DPR -2C
8TPR - 2C
TELE - 2C
MFGXR - 2C
SPARE - 4C
POINT NO.53A
NW - 2C
RW - 2C
CW - 2C
53B
NW - 2C
RW - 2C
CW - 2C
NWKR - 2C
RWKR - 2C
SPARE - 8C
1 HPR - 2C
1DPR - 2C
1 UPR - 2C
C -1HPR - 2C
1MFGXR - 2C
SPARE - 2C
1TPR - 2C
1TPR - 2C
C-1 TPR - 2C
TELE - 2C
SPARE - 4C
POINT NO.
52A
NW - 2C
RW - 2C
CW - 2C
52B
NW - 2C
RW - 2C
CW - 2C
NWKR - 2C
RWKR - 2C
SPARE - 8C
B-1 RG - 2C
B-1 HG - 2C
B-1 DG - 2C
- UG - 2C
C -1 HG - 2C
SPARE - 2C
D1-1 HG -4C
D1 -1HHG -4C
D1 -1DG -4C
SPARE - 7C
D1 -1 HHPR - 2C
D1 - HPR - 2C
MFGXR - 4C
TELE - 2C
SPARE - 6C
D2 - DPR -4C
D2 -1 MFGXR-4C
POINT NO.
51A
NW - 2C
RW - 2C
CW - 2C
51B
NW - 2C
RW - 2C
CW - 2C
NWKR - 2C
RWKR - 2C
TELE - 2C
SPARE - 8C
D2-1 HG - 4C
D2-1HHG -4C
D2-1DG - 4C
SPARE -7C
D2-1DPR -4C
D2 -1MFGXR-4C
TELE -2C
SPARE -2C
D-11-12(6)
PC - 07
PC - 08
PC - 09
PC - 10
PC - 11
PC - 12
S -01 -19(7)
D -02 -12(6)
S -03 -19(7)
D -04 -12(2)
24C POINT 54
D -05 -24(6)
D -06 -24(4)
S -07 - 12(2)
D -08 -12(4)
S -09 -6(2)
D -10 -12(4)
24C POINT 55
D -12 -24(6)
D -13 -12(2)
D -14 -12(6)
D -15 -12(4)
D -16 -12(4)
S -17 -12(4)
24C POINT 56
D -18 -24(6)
D-20-12(6)
PC - 01
PC - 02
PC - 03
PC - 04
PC - 05
PC - 06
D -21 -12(6)
D -22 -19(7)
S -23 -19(7)
D -24 -24(6)
S -25 -12(2)
D -26 -24(4)
S -28 -6(2)
D -29 -19(4)
D -30 -19(5)
D -31 -12(6)12C
D -32 -24(6)24C POINT 51
D -34 -24(8)24C POINT 52
D -38 -24(6)24C POINT 53
D -40 -12(2)12 TPR
D -41 -19(7)19C
S -37 -12(4)

Annexure-5

Guidelines on
Signalling Cable

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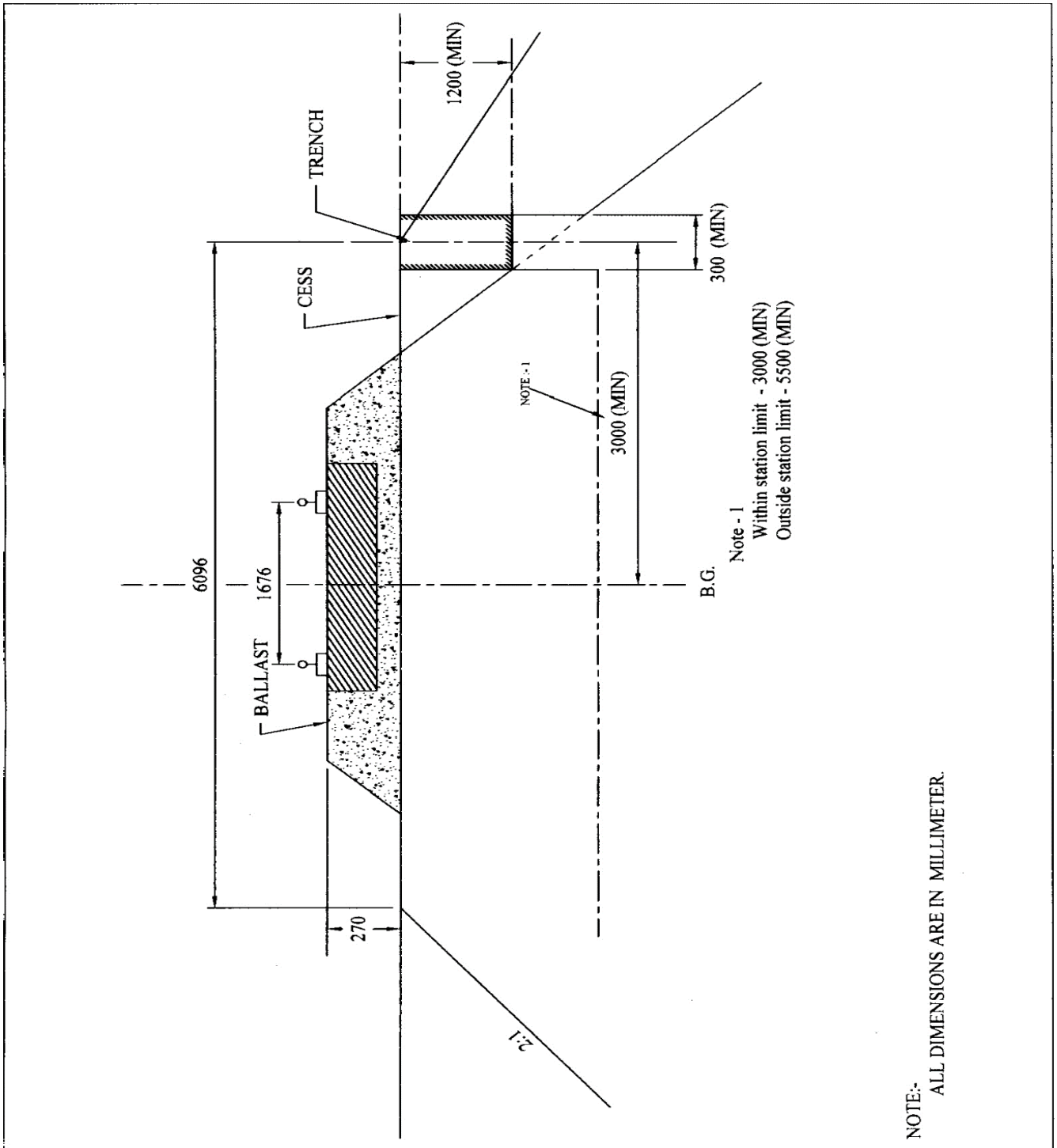
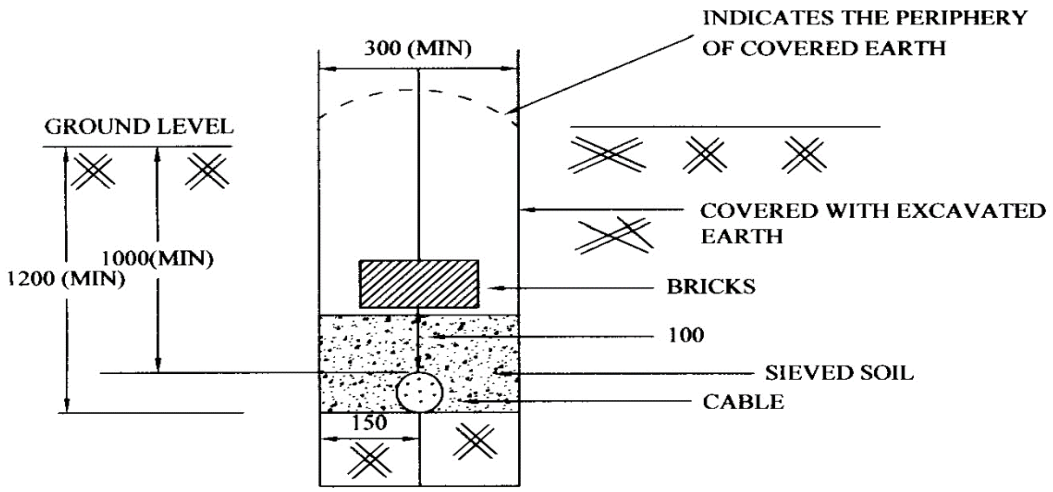
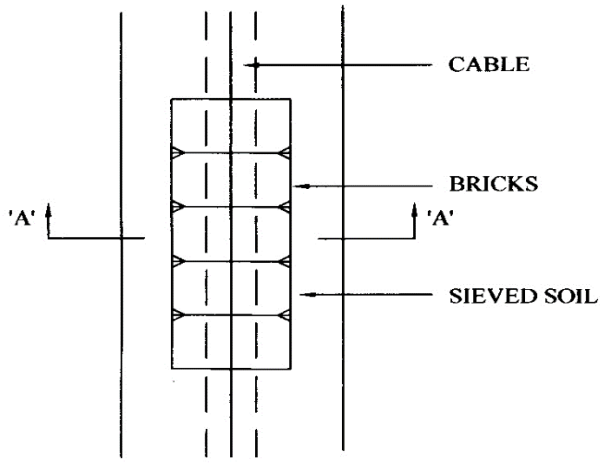


CHECKED BY	JE/SE/SSE	POSITION OF TRENCHES FOR CABLE LAYING	SDO/CABLE LAYING /002
APPROVED BY	ADE	R D S O	DATE : 31-10-2011
NOT TO SCALE			

Annexure-7



CUT SECTION 'AA'



PLAN VIEW

NOTE :
1. ALL DIMENSIONS ARE IN MILLIMETER.

CHECKED BY	JE/SE/SSE	CABLE TRENCH	SDO/CABLE LAYING/003
APPROVED BY	ADE	R. D. S. O.	DATE : 31-10-2011
NOT TO SCALE			

Annexure-8

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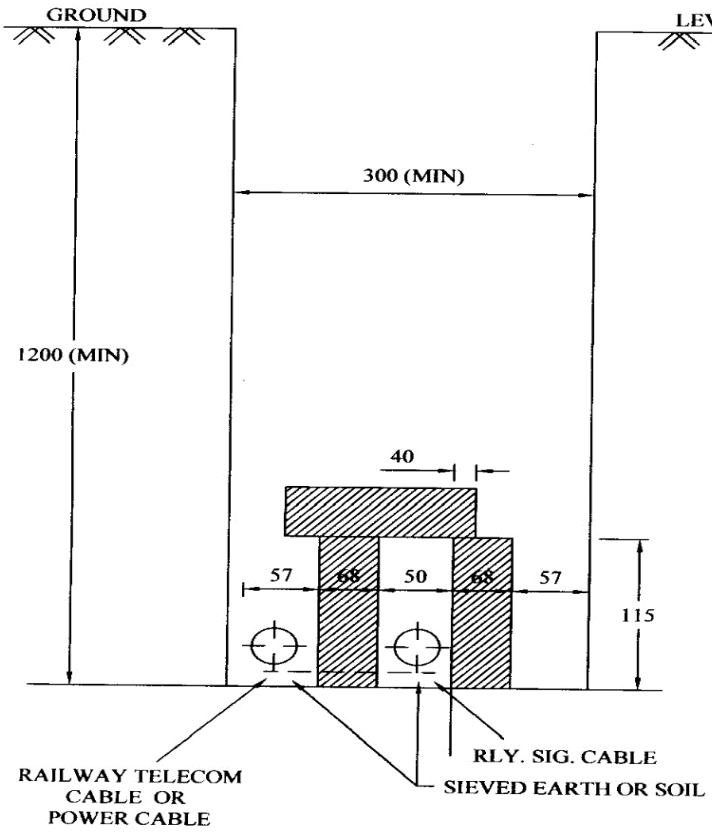
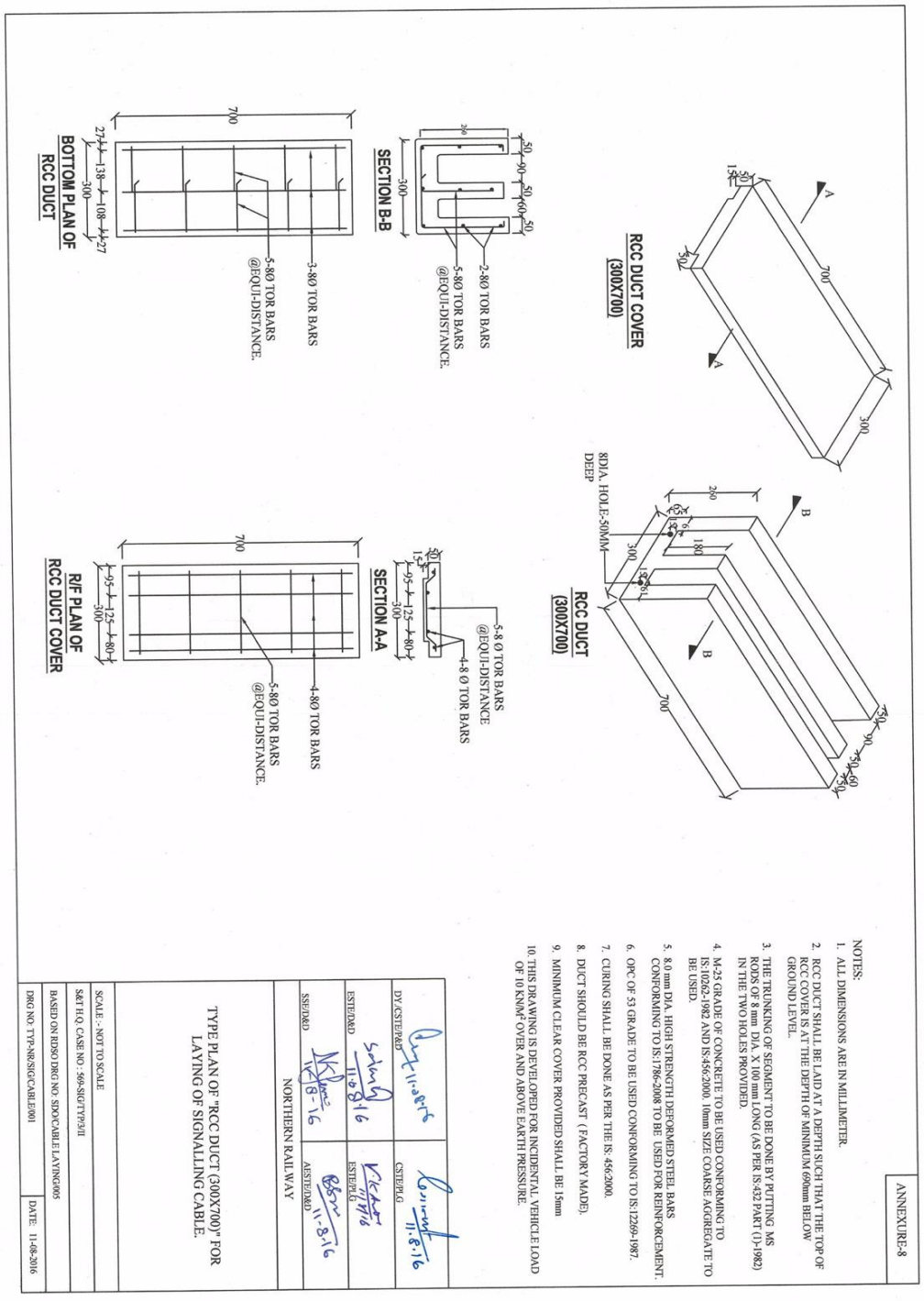
Annexure-9



NOTE:

2. TELECOM CABLE/POWER CABLE TO BE LAID AWAY FROM THE TRACK
1. DIMENSIONS ARE IN MILLIMETRES

CHECKED BY	JE/SE/SSE	LAYING OF SIGNALLING CABLE & TELECOM/POWER CABLE IN SAME TRENCH	SDO/CABLE LAYING/004
APPROVED BY		R. D. S. O.	DATE :- 31-10-2011
NOT TO SCALE			


ANNEXURE-8
NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETER.
2. RCC DUCT SHALL BE LAID AT A DEPTH SUCH THAT THE TOP OF RCC COVER IS AT THE DEPTH OF MINIMUM 600mm BELOW GROUND LEVEL.
3. THE TRUNKING OF SEGMENT TO BE DONE BY PUTTING MS RODS OF 8 mm DIA X 100 mm LONG (AS PER IS:432 PART (1)-1982) IN THE TWO HOLES PROVIDED.
4. M-25 GRADE OF CONCRETE TO BE USED CONFORMING TO IS:10262-1982 AND IS:456:2000. 10mm SIZE COARSE AGGREGATE TO BE USED.
5. 8.0 mm DIA. HIGH STRENGTH DEFORMED STEEL BARS CONFORMING TO IS:1786-2008 TO BE USED FOR REINFORCEMENT.
6. OPC OF 53 GRADE TO BE USED CONFORMING TO IS:12269-1987.
7. CURING SHALL BE DONE AS PER THE IS: 456:2000.
8. DUCT SHOULD BE RCC PRECAST (FACTORY MADE).
9. MINIMUM CLEAR COVER PROVIDED SHALL BE 15mm
10. THIS DRAWING IS DEVELOPED FOR INCIDENTAL VEHICLE LOAD OF 10 KN/M² OVER AND ABOVE EARTH PRESSURE.
RCC DUCT COVER (300X700)
RCC DUCT (300X700)
8DIA. HOLE-50MM DEEP
SECTION B-B
2-8Ø TOR BARS
5-8Ø TOR BARS @EQUI-DISTANCE.
SECTION A-A
5-8 Ø TOR BARS @EQUI-DISTANCE
4-8 Ø TOR BARS
BOTTOM PLAN OF RCC DUCT
3-8Ø TOR BARS
5-8Ø TOR BARS @EQUI-DISTANCE.
R/F PLAN OF RCC DUCT COVER
4-8Ø TOR BARS
5-8Ø TOR BARS @EQUI-DISTANCE.
DY.CSTE/P&P
CSTE/P.G
ESTE/DRD
ESTE/P.G
SSE/DRD
AESTE/DRD
NORTHERN RAILWAY
TYPE PLAN OF "RCC DUCT (300X700)" FOR LAYING OF SIGNALLING CABLE.
SCALE :- NOT TO SCALE
S&T H.Q. CASE NO.: 569-SIG/TYP/3/II
BASED ON RDSO DRG NO. SDO/CABLE LAYING/005
DRG NO. TYP-NR/SIG/CABLE/001
DATE: 11-08-2016

ANNEXURE-9

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETER.
2. RCC DUCT SHALL BE LAID AT A DEPTH SUCH THAT THE TOP OF RCC COVER IS AT THE DEPTH OF MINIMUM 600mm BELOW GROUND LEVEL.
3. THE TRUNKING OF SEGMENT TO BE DONE BY PUTTING MS RODS OF 8 mm DIA. X 100 mm LONG (AS PER IS:432 PART (1)-1982) IN THE TWO HOLES PROVIDED.
4. M-25 GRADE OF CONCRETE TO BE USED CONFORMING TO IS:10262-1982 AND IS:456-2000. 10mm SIZE COARSE AGGREGATE TO BE USED.
5. 8.0 mm DIA. HIGH STRENGTH DEFORMED STEEL BARS CONFORMING TO IS:1786-2008 TO BE USED FOR REINFORCEMENT.
6. OPC OF 53 GRADE TO BE USED CONFORMING TO IS:12269-1987.
7. CURING SHALL BE DONE AS PER THE IS: 456:2000.
8. DUCT SHOULD BE RCC PRECAST (FACTORY MADE).
9. MINIMUM CLEAR COVER PROVIDED SHALL BE 15mm
10. THIS DRAWING IS DEVELOPED FOR INCIDENTAL VEHICLE LOAD OF 10 KN/M² OVER AND ABOVE EARTH PRESSURE.

DY CSTE/P&D	CSTE/P&G	
ESTE/P&D	ESTO/P&G	
SSE/P&D	AESTE/P&D	
NORTHERN RAILWAY		

TYPE PLAN OF "RCC DUCT (500X700)" FOR LAYING OF SIGNALLING CABLE.

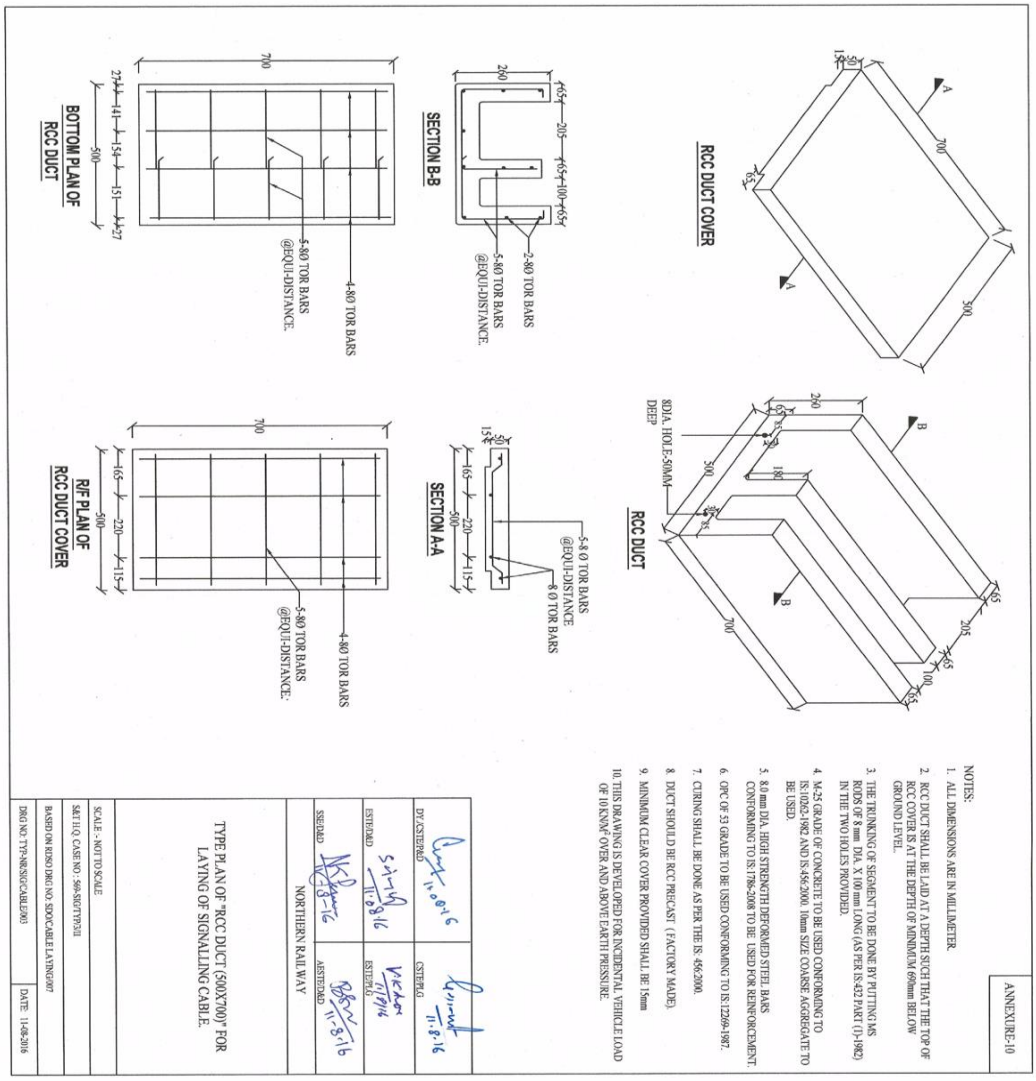
SCALE :- NOT TO SCALE

S&T H.Q. CASE NO : 569-SIG/TYPE/XII

BASED ON RDSO DRG NO: SDO/CABLE LAYING/006

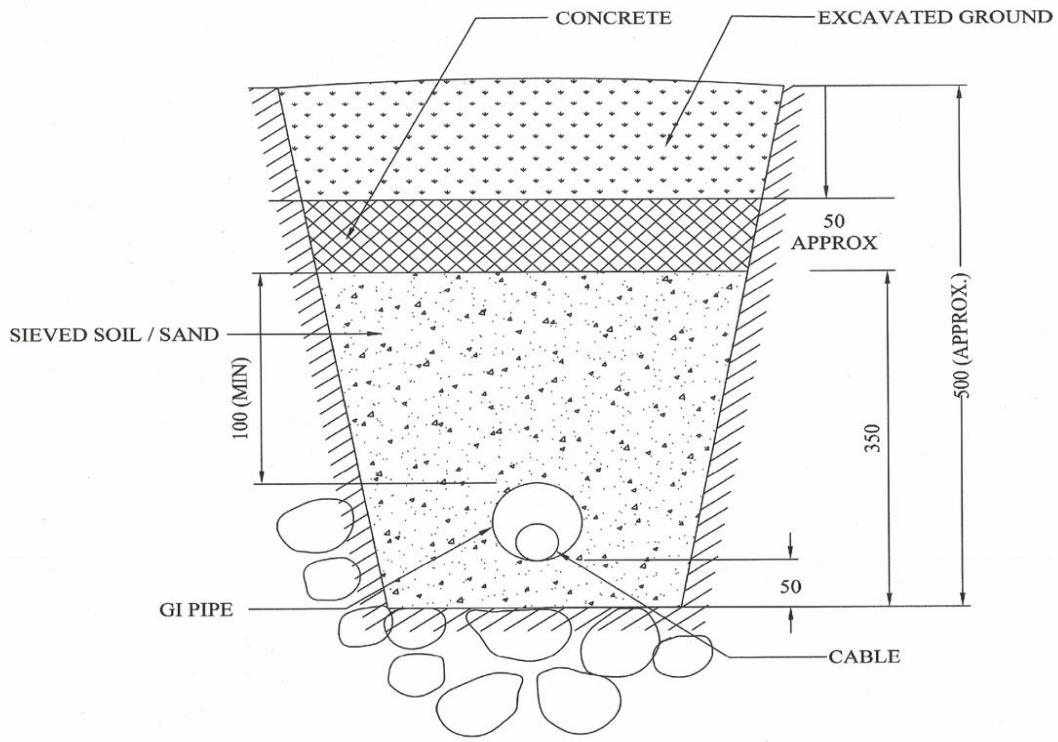
DRG NO: TYP-NR/SIG/CABLE/002 | DATE: 11-08-2016

Annexure-10


ANNEXURE-10
NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETER.
2. RCC DUCT SHALL BE LAID AT A DEPTH SUCH THAT THE TOP OF RCC COVER IS AT THE DEPTH OF MINIMUM 600mm BELOW GROUND LEVEL.
3. THE TRUNKING OF SEGMENT TO BE DONE BY PUTTING M.S RODS OF 8 mm DIA. X 100 mm LONG (AS PER IS:432 PART (1)-1982) IN THE TWO HOLES PROVIDED.
4. M-25 GRADE OF CONCRETE TO BE USED CONFORMING TO IS:10262-1982 AND IS:456:2000. 10mm SIZE COARSE AGGREGATE TO BE USED.
5. 8.0 mm DIA. HIGH STRENGTH DEFORMED STEEL BARS CONFORMING TO IS: 1786-2008 TO BE USED FOR REINFORCEMENT.
6. OPC OF 53 GRADE TO BE USED CONFORMING TO IS 12269-1987.
7. CURING SHALL BE DONE AS PER THE IS: 456:2000.
8. DUCT SHOULD BE RCC PRECAST (FACTORY MADE).
9. MINIMUM CLEAR COVER PROVIDED SHALL BE 15mm
10. THIS DRAWING IS DEVELOPED FOR INCIDENTAL VEHICLE LOAD OF 10 KN/M² OVER AND ABOVE EARTH PRESSURE.
RCC DUCT COVER
RCC DUCT
SECTION B-B
SECTION A-A
BOTTOM PLAN OF RCC DUCT
R/F PLAN OF RCC DUCT COVER
4-8Φ TOR BARS
5-8Φ TOR BARS @EQUI-DISTANCE.
2-8Φ TOR BARS
TYPE PLAN OF "RCC DUCT (500X700)" FOR LAYING OF SIGNALLING CABLE.
NORTHERN RAILWAY
SCALE :- NOT TO SCALE
SHEET I/Q CASE NO :- 566-SIG/TYP/3/II
BASED ON RDSO DRG NO: SDO/CABLE LAYING/007
DRG NO: TYP-NR/SIG/CABLE/003
DATE: 11/08/2016

Annexure-11

ANNEXURE-11



NOTE:-

(i)ALL DIMENSIONS ARE IN MILLIMETER.

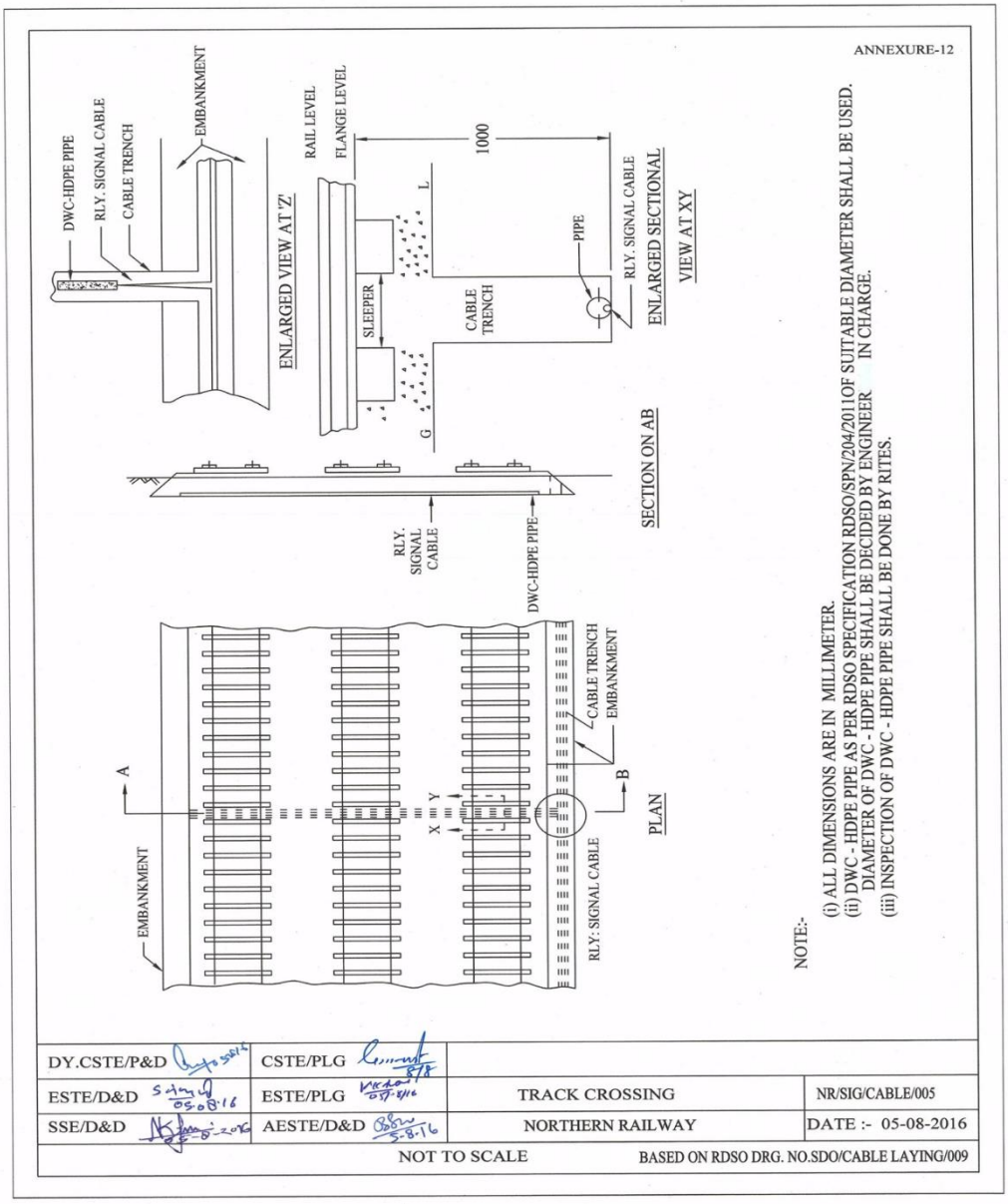
(ii) G.I PIPE OF MEDIUM GRADE OF ISI MARK AS PER IS:1239(PART-I) OF SUITABLE DIAMETER SHALL BE USED. DIAMETER OF G.I.PIPE SHALL BE DECIDED BY ENGINEER IN CHARGE.

(iii) INSPECTION OF G.I PIPE SHALL BE DONE BY RITES.

DY.CSTE/P&D	CSTE/PLG		
ESTE/D&D	ESTE/PLG	LAYING OF CABLES IN ROCKY AREA	NR/SIG/CABLE/004
SSE/D&D	AESTE/D&D	NORTHERN RAILWAY	DATE :- 05-08-2016
	NOT TO SCALE	BASED ON RDSO DRG. NO.SDO/CABLE LAYING/008	

Annexure 12

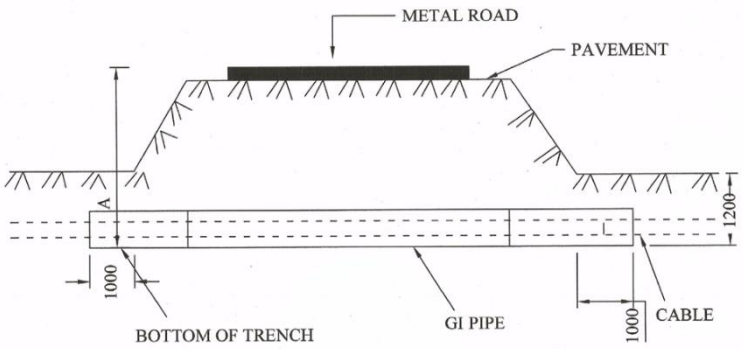
Annexure-12



Annexure-13

Annexure 13

ANNEXURE-13



NOTE:-

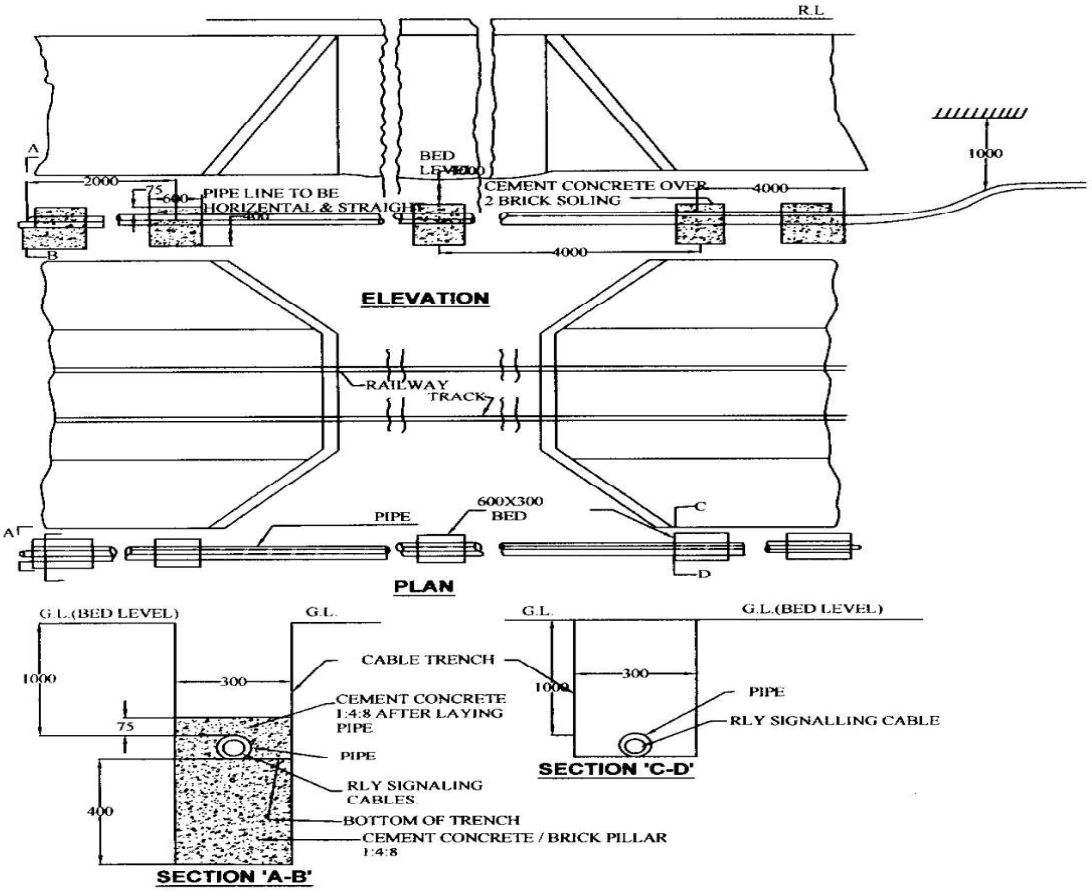
(i) ALL DIMENSIONS ARE IN MILLIMETER.

(ii) G.I PIPE OF MEDIUM GRADE OF ISI MARK AS PER IS:1239(PART-I) OF SUITABLE DIAMETER SHALL BE USED. DIAMETER OF G.I.PIPE SHALL BE DECIDED BY ENGINEER IN CHARGE.

(iii) INSPECTION OF G.I.PIPE SHALL BE DONE BY RITES.

DY.CSTE/P&D	CSTE/PLG		
ESTE/D&D	ESTE/PLG	ROAD CROSSINGS	NR/SIG/CABLE/006
SSE/D&D	AESTE/D&D	NORTHERN RAILWAY	DATE :- 05-08-2016
	NOT TO SCALE	BASED ON RDSO DRG. NO.SDO/CABLE LAYING/010	

Annexure-14



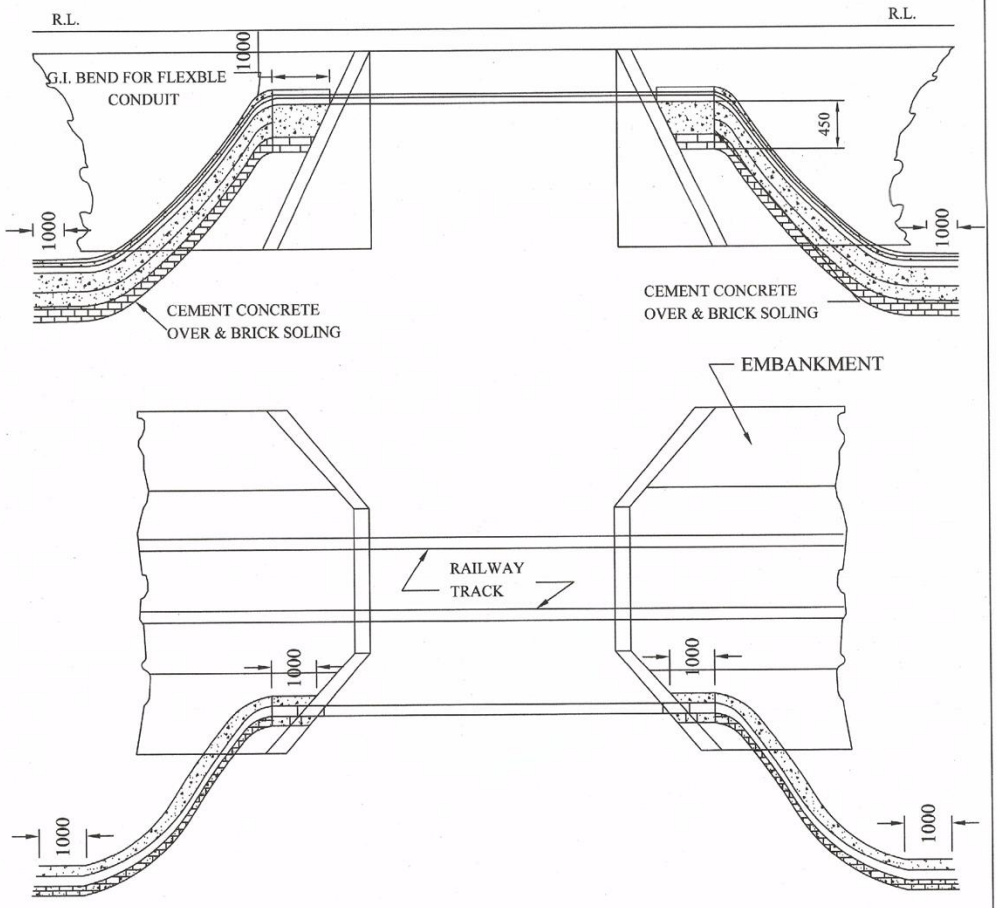
NOTE:-

ALL DIMENSIONS ARE IN MILLIMETER.

CHECKED BY	JE/SE/SSE	CABLE LAYING ON CULVERTS WITH LOW FLOOD LEVEL	SDO/CABLE LAYING/011
APPROVED BY	ADE	R.D.S.O	DATE :- 31-10-2011
NOT TO SCALE			

Annexure-15

ANNEXURE-15



NOTE:-

(i) ALL DIMENSIONS ARE IN MILLIMETER.

(ii) ON APPROACH OF CULVERTS, DWC- HDPE PIPE OF SUITABLE DIAMETERAS PER RDSO SPECIFICATION RDSO/SPN/204/2011 SHALL BE USED.DIAMETER OF DWC -HDPE PIPE SHALL BE DECIDED BY ENGINEER IN CHARGE.

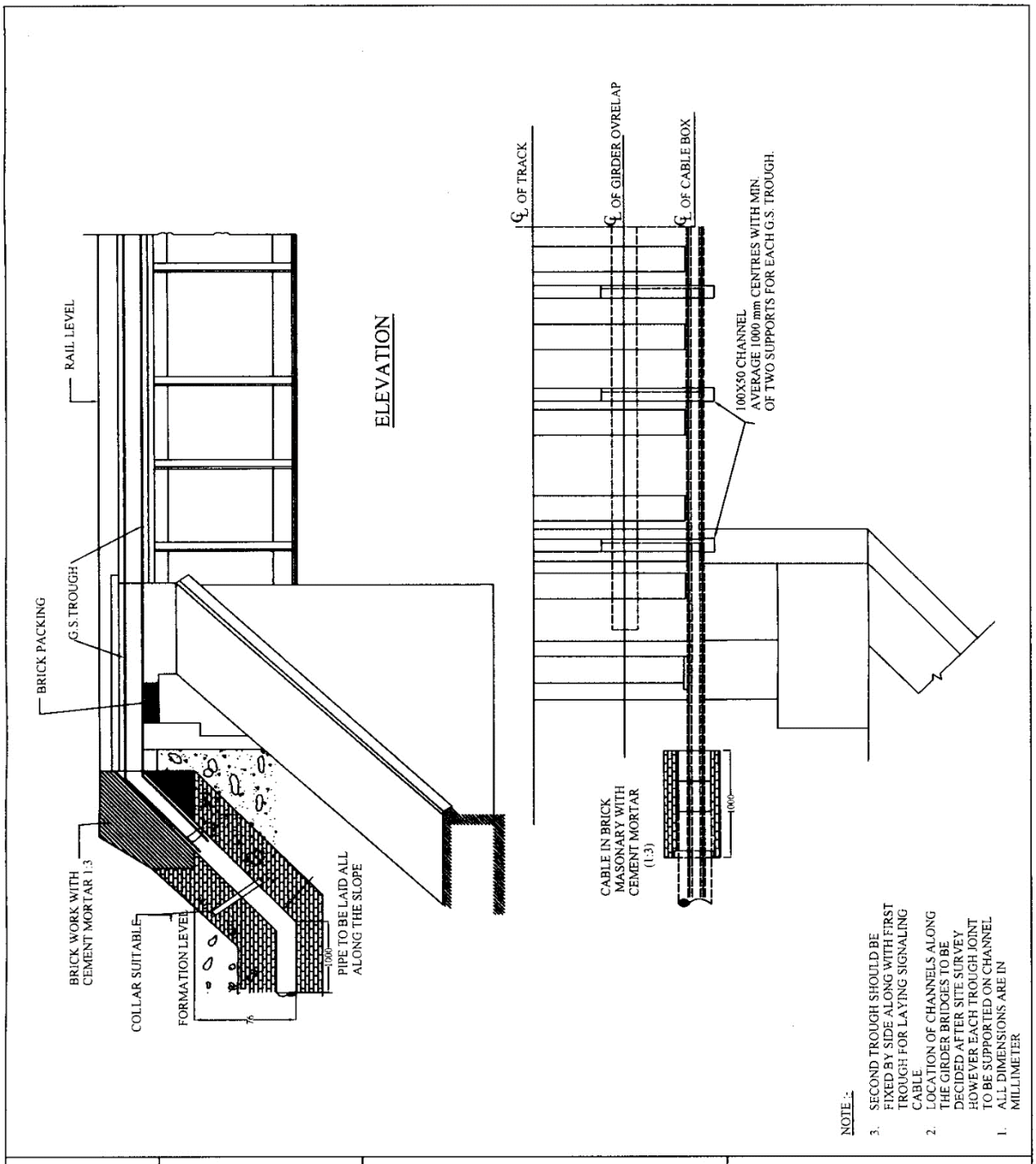
(iii) ON CULVERT PORTION, PERFORATED G.I PIPE OF MEDIUM GRADE OF ISI MARK AS PER IS:1239(PART-I) OF SUITABLE DIAMETER SHALL BE USED. DIAMETER OF G.I.PIPE SHALL BE DECIDED BY ENGINEER IN CHARGE.

(iv) AT JUNCTION POINT OF G.I AND DWC PIPE, A G.I.BEND OF 112.5 DEGREE,1 MTR. LENGTH AS PER IS-1239(Part-2) AND OVERLAPPING 250MM. WITH DWC PIPE SHALL BE USED.

(v) INSPECTION OF DWC-HDPE AND G.I. PIPE SHALL BE DONE BY RITES.

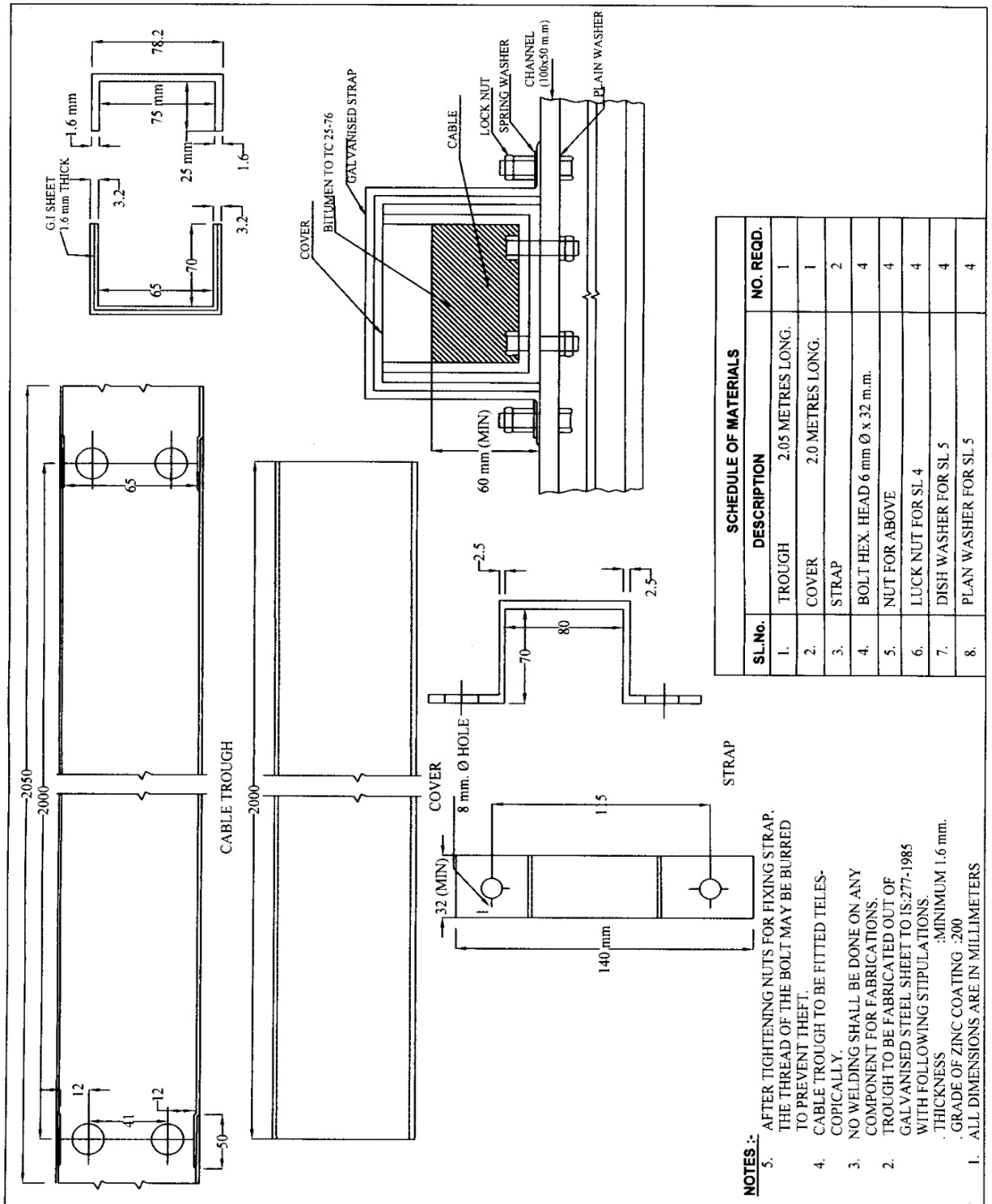
DY.CSTE/P&D	CSTE/PLG		
ESTE/D&D	ESTE/PLG	CABLE LAYING ON CULVERTS WITH HIGH FLOOD LEVEL	NR/SIG/CABLE/007
SSE/D&D	AESTE/D&D	NORTHERN RAILWAY	DATE :- 05-08-2016
NOT TO SCALE		BASED ON RDSO DRG. NO.SDO/CABLE LAYING/012	

Annexure-16



CHECKED BY	JE/SE/SSE	CABLE LAYING ON METALLIC BRIDGES	SDO/CABLE LAYING/013
APPROVED BY	ADE	R. D. S. O.	DATE :- 31-10-2011
NOT TO SCALE			

Annexure-17



SCHEDULE OF MATERIALS

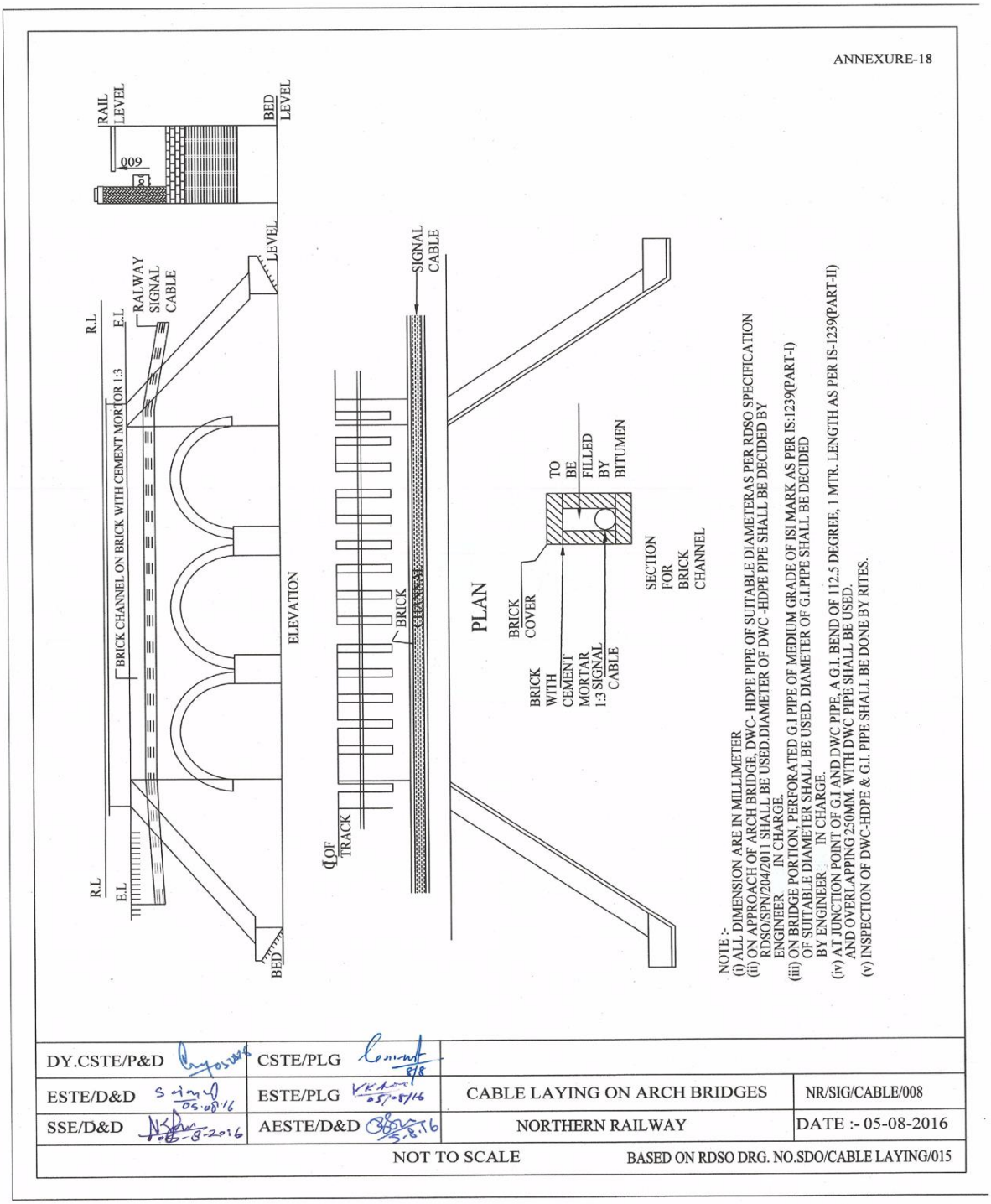
SL.No.	DESCRIPTION	NO. REQD.
1.	TROUGH 2.05 METRES LONG.	1
2.	COVER 2.0 METRES LONG.	1
3.	STRAP	2
4.	BOLT HEX. HEAD 6 mm Ø x 32 m.m.	4
5.	NUT FOR ABOVE	4
6.	LUCK NUT FOR SL 4	4
7.	DISH WASHER FOR SL 5	4
8.	PLAN WASHER FOR SL 5	4

NOTES :-

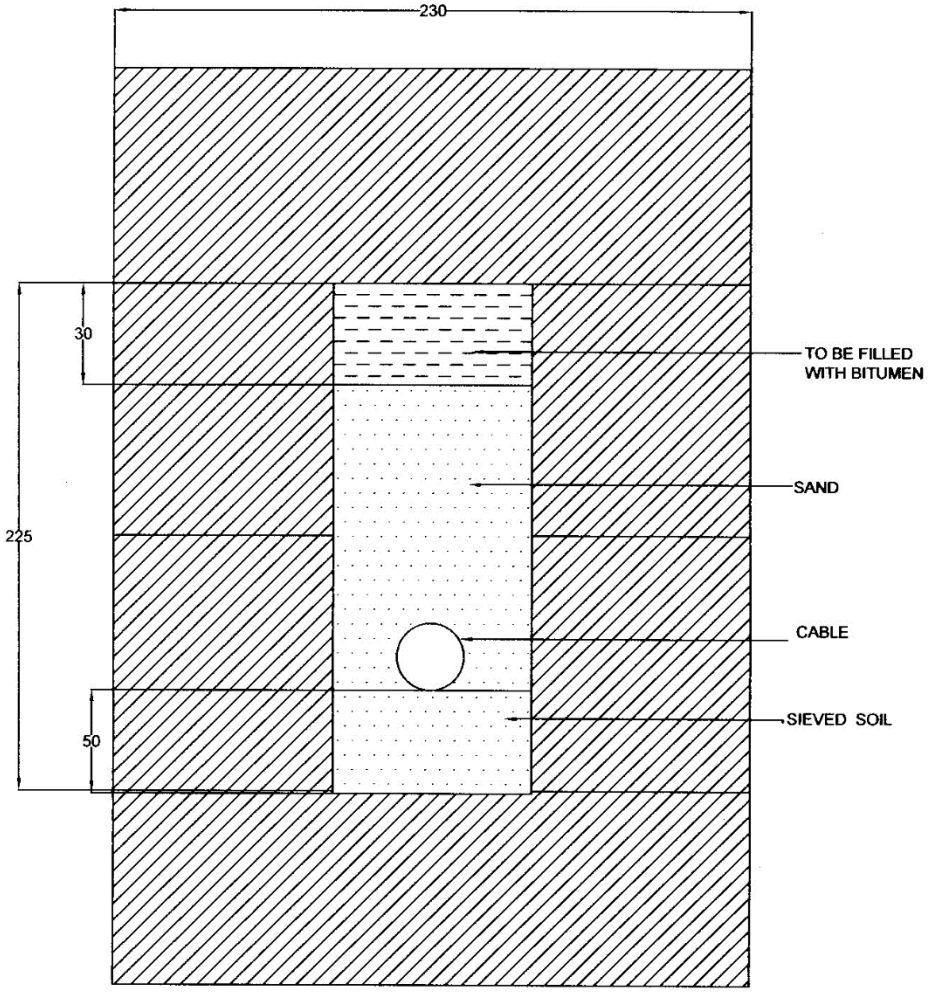
5. AFTER TIGHTENING NUTS FOR FIXING STRAP, THE THREAD OF THE BOLT MAY BE BURRED TO PREVENT THEFT.
4. CABLE TROUGH TO BE FITTED TELESCOPICALLY.
3. NO WELDING SHALL BE DONE ON ANY COMPONENT FOR FABRICATIONS.
2. TROUGH TO BE FABRICATED OUT OF GALVANISED STEEL SHEET TO IS:277-1985 WITH FOLLOWING STIPULATIONS.
   - THICKNESS :MINIMUM 1.6 mm.
   - GRADE OF ZINC COATING :200
1. ALL DIMENSIONS ARE IN MILLIMETERS

CHECKED BY	JE/SE/SSE	CABLE TROUGH FOR METALLIC BRIDGES	SDO/CABLE LAYING/014
APPROVED BY	ADE	R. D. S. O.	DATE :- 31-10-2011
NOT TO SCALE			

Annexure-18


ANNEXURE-18
RAIL LEVEL
BED LEVEL
009
LEVEL
RALWAY SIGNAL CABLE
R.L
E.L
BRICK CHANNEL ON BRICK WITH CEMENT MORTOR 1:3
ELEVATION
R.L
E.L
BED
SIGNAL CABLE
BRICK CHANNEL
BRICK
OF TRACK
PLAN
BRICK COVER
BRICK WITH CEMENT MORTAR 1:3 SIGNAL CABLE
TO BE FILLED BY BITUMEN
SECTION FOR BRICK CHANNEL
NOTE :-
(i) ALL DIMENSION ARE IN MILLIMETER
(ii) ON APPROACH OF ARCH BRIDGE, DWC- HDPE PIPE OF SUITABLE DIAMETERAS PER RDSO SPECIFICATION RDSO/SPN/204/2011 SHALL BE USED.DIAMETER OF DWC -HDPE PIPE SHALL BE DECIDED BY ENGINEER IN CHARGE.
(iii) ON BRIDGE PORTION, PERFORATED G.I PIPE OF MEDIUM GRADE OF ISI MARK AS PER IS:1239(PART-I) OF SUITABLE DIAMETER SHALL BE USED. DIAMETER OF G.I.PIPE SHALL BE DECIDED BY ENGINEER IN CHARGE.
(iv) AT JUNCTION POINT OF G.I AND DWC PIPE, A G.I. BEND OF 112.5 DEGREE, 1 MTR. LENGTH AS PER IS-1239(PART-II) AND OVERLAPPING 250MM. WITH DWC PIPE SHALL BE USED.
(v) INSPECTION OF DWC-HDPE & G.I. PIPE SHALL BE DONE BY RITES.
DY.CSTE/P&D
CSTE/PLG
ESTE/D&D
ESTE/PLG
SSE/D&D
AESTE/D&D
CABLE LAYING ON ARCH BRIDGES
NR/SIG/CABLE/008
NORTHERN RAILWAY
DATE :- 05-08-2016
NOT TO SCALE
BASED ON RDSO DRG. NO.SDO/CABLE LAYING/015

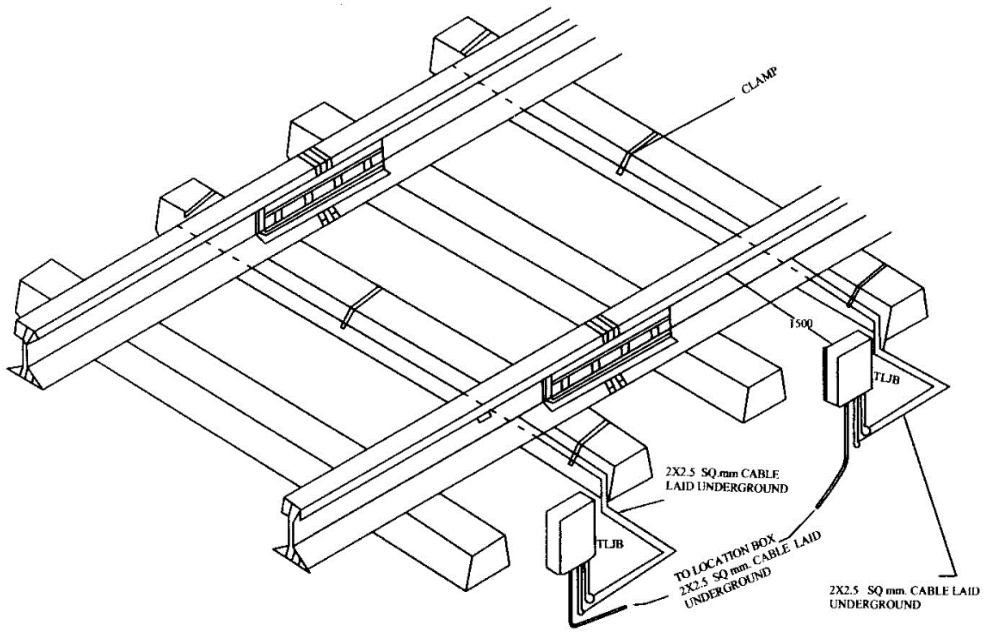
Annexure-19



NOTE :-
ALL DIMENTION ARE IN MILLIMETER.

CHECKED BY	JE/SE/SSE	BRICK MASONRY CHANNEL FOR ARCH BRIDGE	SDO/CABLE LAYING /016
APPROVED BY	ADE	**R. D. S. O.**	DATE :- 31-10-2011
NOT TO SCALE			

Annexure-20

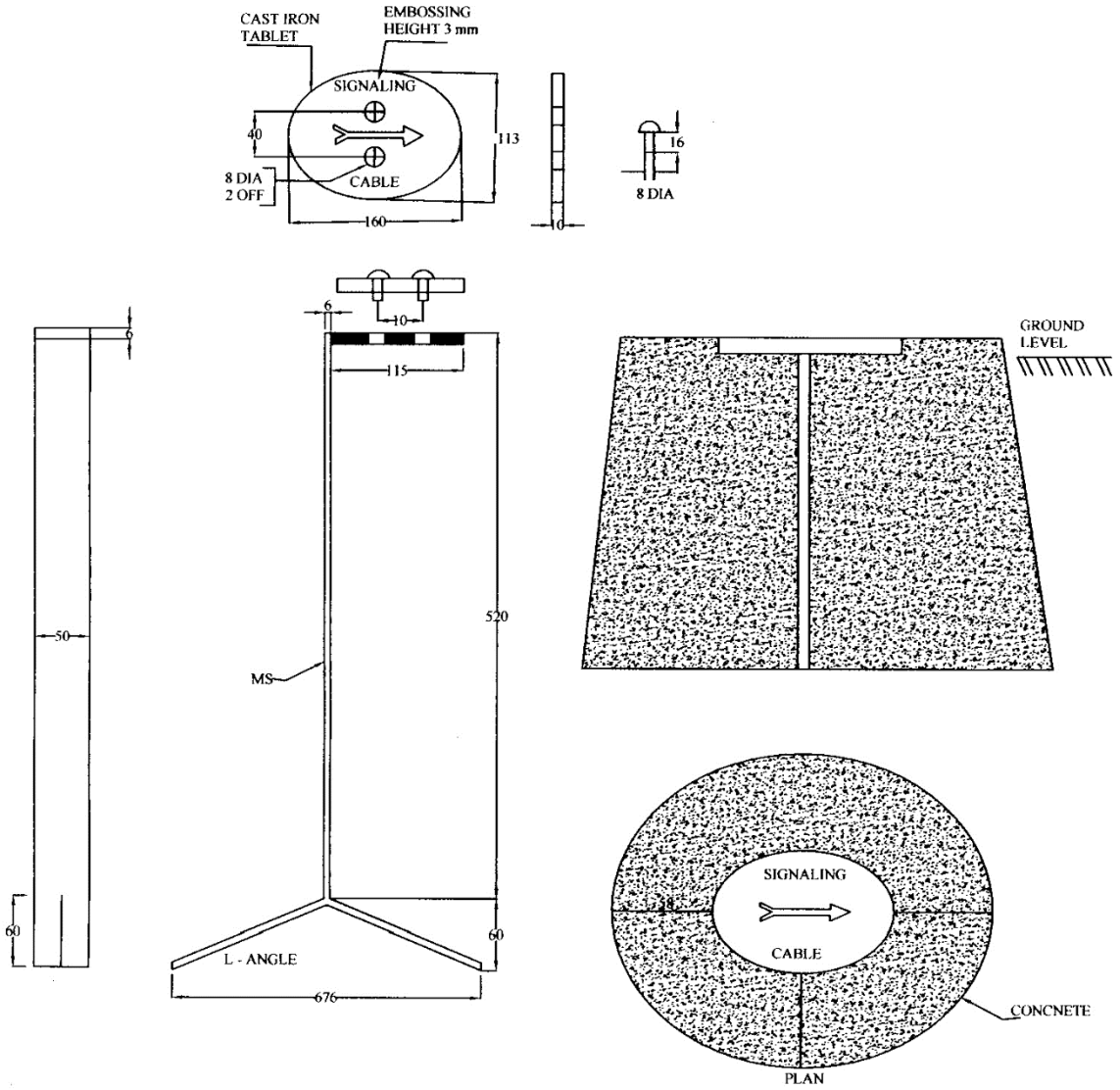


NOTE:-

ALL DIMENSIONS ARE IN MILLIMETER.

CHECKED BY	JE/SE/SSE	ARRANGMENT OF JUMPER CABLE	SDO/CABLE LAYING/017
APPROVED BY	ADE	R.D.S.O	DATE :- 31-10-2011
NOT TO SCALE			

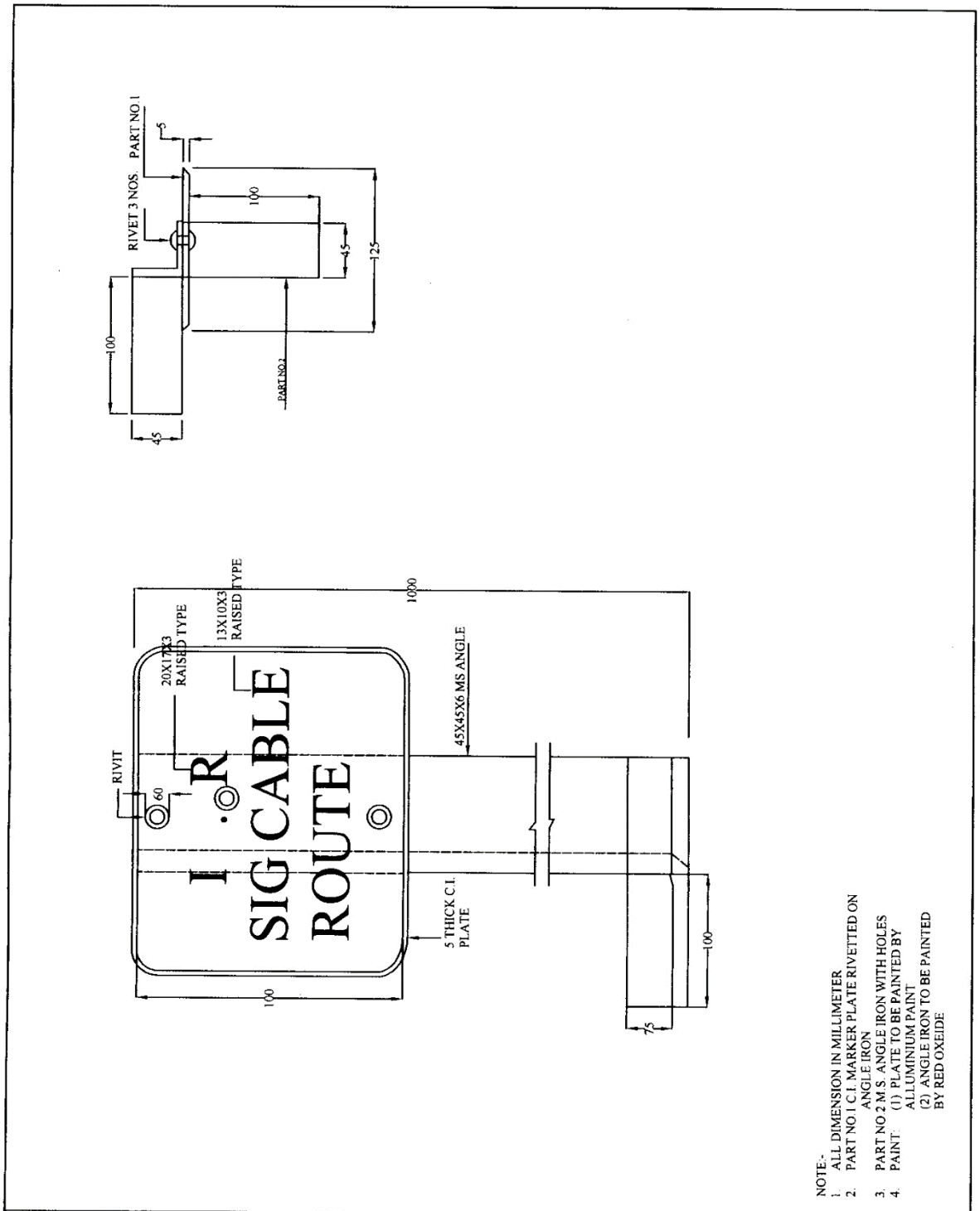
Annexure-21



NOTE :-
1. ALL DIMENSION ARE IN MM.
2. CAST IRON TABLET IS TO BE RIVETTED TO THE L - ANGLE ON THE 2 HOLES.

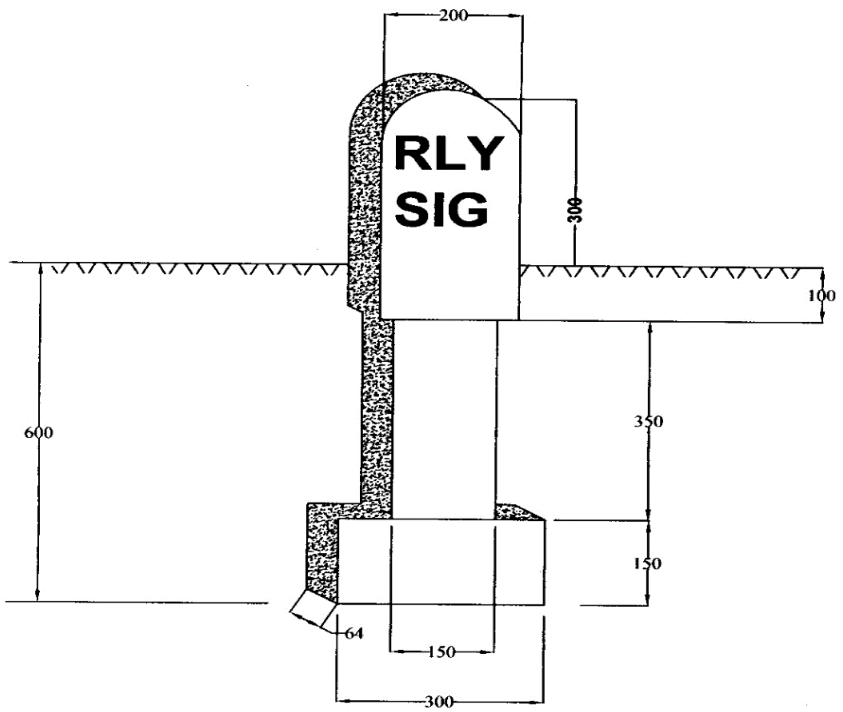
CHECKED BY	JE/SE/SSE	CI CABLE MARKER & CONCRETING	SDO/CABLE LAYING/018
APPROVED BY	ADE	R. D. S. O.	DATE :- 31-10-2011
NOT TO SCALE			

Annexure-22



CHECKED BY	JE/SE/SSE	CI CABLE MARKER	SDO/CABLE LAYING/019
APPROVED BY	ADE	R.D.S.O.	DATE :- 31-10-2011
NOT TO SCALE			

Annexure-23

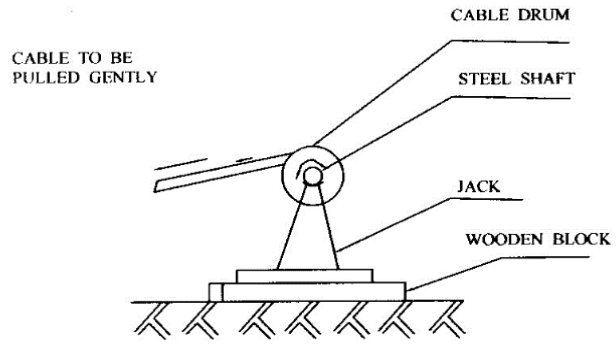


NOTE:-

1. ALL DIMENTIONS ARE IN MILLIMETER
2. PAINTED WHITE LETTERS ON RED BACKGROUND.
3. FOUNDATION CONCRETE OF 300 mm FROM THE BASE OF THE MARKER SHALL BE DONE AT SITE AT ALL PLACES WITH MIX 1:3:5.
4. COMPONENT CONCRETE SHALL BE OF M25 MIX AND WIRE MESH OF 1.5MM THICKMESS SHALL BE USED.
5. THE ENGRAVING OF "RLY" & "SIG" SHALL BE DONE ON BOTH SIDES OF THE MARKER.

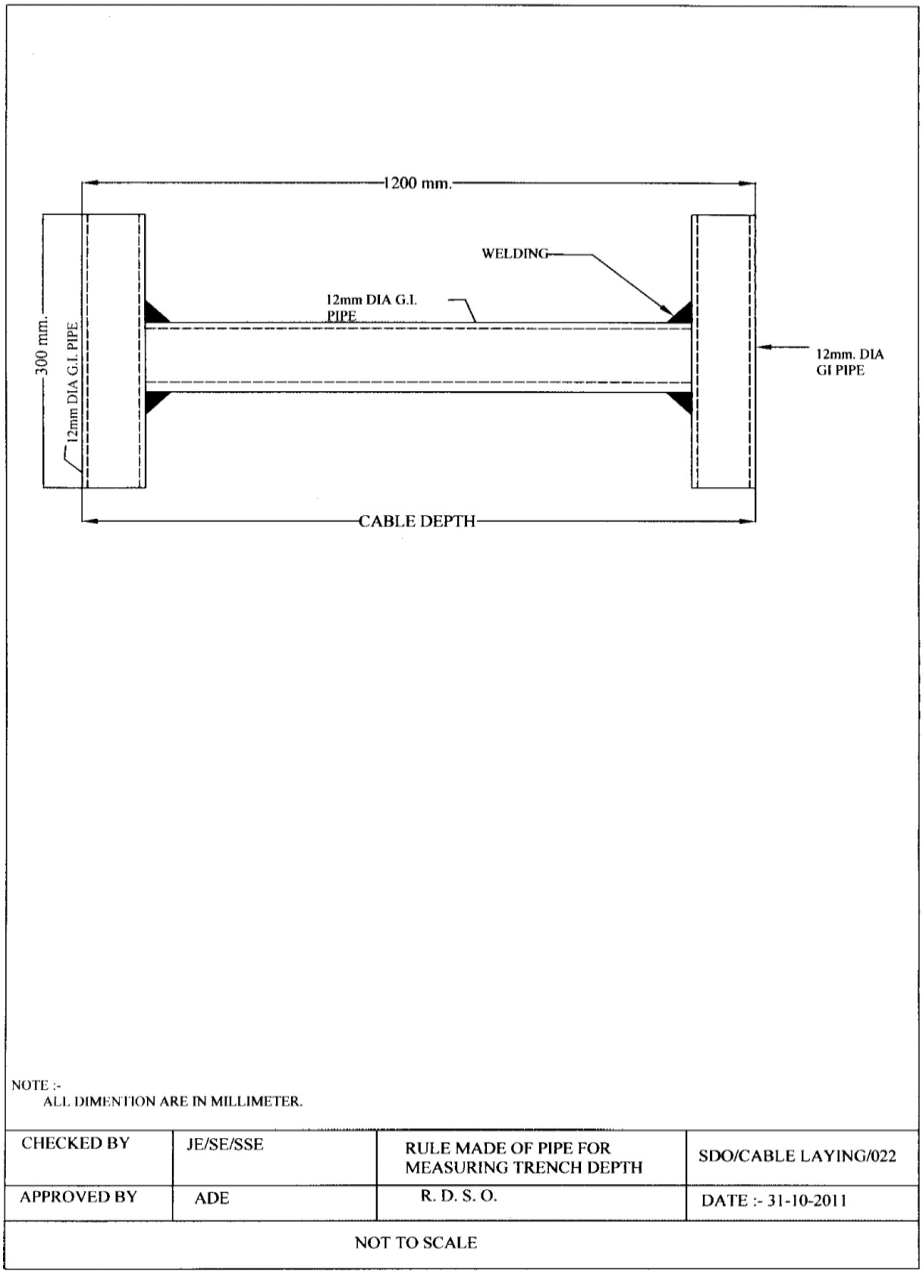
CHECKED BY	JE/SE/SSE	CONCRETE CABLE MARKER	SDO/CABLE LAYING/020
APPROVED BY	ADE	R.D.S.O.	DATE :- 31-10-2011
NOT TO SCALE			

Annexure-24



CHECKED BY	JE/SE/SSE	METHOD OF UNROLLING CABLE	SDO/CABLE LAYING /021
APPROVED BY	ADE	R.D.S.O.	DATE :- 31-10-2011
NOT TO SCALE			

Annexure-25



NOTE :-
ALL DIMENTION ARE IN MILLIMETER.

CHECKED BY	JE/SE/SSE	RULE MADE OF PIPE FOR MEASURING TRENCH DEPTH	SDO/CABLE LAYING/022
APPROVED BY	ADE	R. D. S. O.	DATE :- 31-10-2011
NOT TO SCALE			

Note: ALL the above sketches/Drawings/Diagram given are only indicative. The detailed drawings shall be proposed by the Contractor and approved by the Engineer.

(End of Appendix 2)

Appendix -3 to Section 5-2 PS (Signalling)

Deleted

Guidelines on Signalling and cable laying

Appendix-4

NON - INTERLOCKED WORKING OF STATION

Non Interlocking

i) N.I. Working means temporary disconnection of points, signals, track circuits, axle counters and other signaling gadgets for any designated works. This kind of working is normally resorted to works such as over hauling of lever frames, yard remodeling, introduction of panel/RRI working, cable etc.,

ii) In another sense, at an interlocked station when points and signals become defective, station becomes non-interlocked for the purpose of working.

In both the cases the safeguards ingrained through normal functioning of various signaling equipment are missing and as such responsibility of the part of staff increases manifold. N.I. working puts staff under severe strain and hence prone for lapses. Unflagging attention from every quarter is the need of the hour so that safety is ensured.

Non - Interlocked working entails not only slowing down of train operations; it is also a less safe system as compared to interlocked working. Since it is desirable to avoid NI altogether, both from safety as also customer convenience point of view, attempt must be made at the project proposal stage itself to dispense with NI altogether and undertake the work by means of traffic blocks.

Instructions given below are in addition to existing rules for Non - Interlocked working such as issue of Green Notice etc. They must be read together with existing provisions in G&SR, Block Working Manual etc.

A. Requirement of Non - Interlocked Working:

The following guidelines are laid down for a correct assessment of whether NI working is required in the first place or whether it can be dispensed with altogether.

a. NI working should not be resorted to as far as possible, in case of installation of new S&T gears. NI is unavoidable only if modifications are to be made to existing S&T gears.
b. For new S&T gears, there is no need of NI and the work can be managed through well- planned pre-change over works (insertions of point & crossing etc). The final change over to new gears can be carried out under partial or complete traffic block.
c. At the project proposal stage itself, S&T department should make it clear whether the project requires NI or not; and if it does, the duration of such NI. This fact must be mentioned in the check list on the original tracing itself.
d. Sr. DOM & Sr. DCM must quantify the actual impact of such NI, and deduce it to monetary terms, by calculating anticipated losses both on account of passenger and freight traffic. These should include losses on account of cancellation, short termination, diversion, rescheduling, detention to trains and imposition of restriction on booking/movement of freight traffic.

e. Expenses likely to be incurred on account of TA/DA of temporary NI staff, and other administrative costs should also be added to arrive at the traffic cost of proposed NI working.

f. This traffic cost of NI should be communicated to S&T, who will evaluate if new gears can be installed without resorting to NI for less than the expected cost of proposed NI, if necessary by constructing a new building etc. as the case may be.

g. If new gears can be installed in a new building and commissioned under traffic block at a cost that is comparatively less than the overall traffic cost of proposed NI, then the project should be recorded as one to be taken up without NI.

h. This entire exercise must be carried out under the personal supervision of DRM, who will ensure that all estimates are reasonable and no figures are unrealistic both with regard to duration of NI or the anticipated traffic cost.

i. Thus, NI will be undertaken only if found to be unavoidable, and this fact will be recorded on the original tracing, to be signed by branch officers concerned, and the DRM.

Minor and Major Works :

1. Guidelines given below should be followed for deciding whether NI working is required or not. NI working is not required and the work can be managed by traffic block in following cases :
   (i) Replacement of Mechanical lever frame by another Mechanical lever frame.
   (ii) Replacement of Mechanical lever frame by panel.
   (iii) Replacement of Panel by RRI.
   (iv) Replacement of RRI by RRI.
   (v) Commissioning of new SSI/RRI.
   (vi) Amalgamation of newly constructed double line portion into existing conventional double line.
2. NI working is required only for following cases :
   (i) Overhauling of cabins.
   (ii) Replacement of Panel by Panel at road side stations.
   (iii) Meggering of cables.
   (iv) Changes in yard layouts
3. NI working can be divided into 2 distinct categories, namely minor and major works.
   (i) Minor works - Overhauling of cabins at road side stations.
   (ii) Major works - Changes in yard layouts, overhauling of cabins etc. at comparatively bigger terminals and junction stations.

MINOR WOHKS

(A) Procedure to be followed for Non - Interlocked Working for Minor Works :
Road side stations on double line having up to 2 lines in each direction, and on single line having up to one main line and 2 loop lines are covered under this heading of Minor Works.

(C1) Duration of NI workinq for Minor Works :

1. A road side station would normally have about 21 lever in each end cabin (including spare levers).
2. S&T department must suitably augment the strength of their NI gang so that each cabin can be completed in one day.
3. NI working at the 1 ^{t} cabin should start at 8/- hrs. in the morning and by 18/- hrs. the same must be interlocked and handed back to traffic.
4. The same procedure should be repeated the next day for the 2'^{d} cabin. (C2) General Instructions for Train Operation :
1. Speed restriction of 15 kmph. shall be imposed over all facing points.

2. No train/wagon should be stabled on any running line of the NI station.
3. The common line should not be used for reception of trains coming from opposite directions.
4. Emergency and other crossovers including sidings taking off from the station should be set for normal position and clamped and padlocked. The keys of all padlocked points must be kept in the personal custody of the overall in-charge of NI working to prevent their being used even by mistake.

(C3) Train Running on double line section during NI working :

1. Twin single line should be suspended during the duration of NI working and section worked as conventional double line only.
2. No temporary single line working should be introduced during NI period, except in case of an accident or blockade of through communication.
3. At road side stations on double line, route must be set for platform line in each direction and clamped and padlocked.
4. In case there is more than one platform in each direction, route must be set for one nominated platform.
5. At all such stations no precedence should be arranged.
6. During the NI period station should basically function as a halt station.

(C4) Train Running on single line section during NI working :

1. Ideally, if possible, only one platform line should be nominated for train running.
2. The route must be set for this platform line in each direction and clamped and padlocked.
3. No precedence or crossing should be arranged at this station.
4. In case it is not possible to nominate only one line, then 2 specific lines should be nominated for Up and Down movement.
5. In that case, while crossings would have to take place, no precedence should be arranged at this station.

(C5) Staff requirement :

1. Sectional TI and SI will be overall in-charge of NI working at the station.
2. Additional staff if required should be managed locally .

MAZOR WORKS

Procedure to be followed for Non - Interlocked Working for Major Works :

Changes in yard layouts, overhauling of cabins etc. at comparatively bigger terminals and junction stations are covered under this heading of Major Works.

(D1) Duration of Non Interlocked Working :

1. NI working must not be simultaneously introduced at more than one station in a Division.
2. NI must be planned during temperate weather, to avoid wrong actions on account of harsh and inclement weather.
3. Period of Non - interlocked working must be kept to the bare minimum as it is a potential safety hazard.
4. Staff of all departments must work round the clock in three shifts so that the work can be completed at the earliest.
5. For NI working of up to 3 days, plans will be finalized in consultation with DRM, Branch Officers and concerned HOD of Construction/RE Organization.
6. For NI working of more than 3 days, plans will be finalized in consultation with CTPM, CPTM and HOD of RE/Construction Organization at Zonal level to assess the duration and arrangements of NI working.
7. For more than 3 days NI, plans should be worked out for cancellation, diversion, rescheduling, short termination or even extension of trains as the case may be.
8. For NI working of more than 7 days personal approval of the General Manager must be obtained.
9. No NI working should last for more than 14 days.

(D2) Sanctions, clearances and preparatory works :

1. Signal Plan must be finalised in Hdqrts. at least 45 days in advance.
2. All plans and clearances including CRS sanctions that are required for NI working must be available at least 1 month before commencement of NI working.
3. Under no circumstances should this period of 1 month be relaxed.
4. NI working must be postponed in order to provide for 1 clear month before start of NI either in case of :
   (i) Delay in receipt of above clearances/sanctions etc.
   (ii) Last minute modifications to Signal Plan.
5. All pre - NI work that can be carried out without non - interlocking must be completed before actual NI working begins. These include changes in yard layout, insertion /removaI of points & crossings etc. Changing/installation of new point machines must be done in advance.
6. Preparatory work in connection with OHE work must also be done in advance, including shifting of neutral section, if required.
7. Lessons learnt during previous Nls must be gone through in detail so that shortcomings of earlier occasions are avoided.

(D3) Level of Supervision/Responsibility :

1. Responsibility to ensure availability of proper arrangement for NI working shall be of Construction/RE organization.
2. Though the responsibility to provide necessary arrangement will be of Construction/RE organization, concerned branch officers from open line shall be responsible to ensure its availability and functioning during train operation. For this he shall be the coordinating officer for the department concerned.
3. PERT chart should be made out detailing various activities to be completed on a day-to-day basis.
4. For round the clock working PERT chart should be made out detailing various activities to be completed on a shift to shift basis.
5. Dy. CSTE/Dy. CE/Dy. CEE as applicable shall make themselves available in non-interlocked area where the work is being undertaken.
6. The concerned Project in - charge (XEN, DSTE/Con. etc) shall camp near the non-interlocked area till completion of non-interlocked working.
7. Overall in charge for NI working will be Sr. DOM/DOM as the case may be for both Safety and Operations.

(D4) Green Notice :

1. Construction officials responsible for carrying out the work should send a 'circular notice' to the Sr. DOM/Sr. DSO at least two months in advance.
2. They will advise as to when the work will be undertaken with a request to issue special instructions. A copy of the notice shall also to be sent to SS of the station concerned.
3. Sr. DOM/Sr. DSO on receiving such 'circular notice' get special instructions prepared for that station. These are then issued to all concerned.
4. Green notice is to be issued by Sr. DOM. It should incorporate the following :
   (i) Details of existing yard layout and its various provisions.
   (ii) List of all works to be completed by Civil Engg./S&T/Elec. before start of NI.

(iii) List of all works to be undertaken by Civil Engg./S&T/Elec. during NI period.
(iv) Additional facilities to be made available after commissioning of new works.
(v) Existing facilities that are to be dismantled.
(vi) Details of yard layout to be made available after completion of NI.

5. Signalling Plan must indicate permissible routings and simultaneous movement facilities to be made available.
6. Signalling Plan must invariably indicate whether any of existing facilities for train movement are to be (i) either curtailed, (ii) modified or (iii) restricted.

(D5) Time Tabling changes :

For assessing the impact of NI working at a bigger terminal or at a Junction station, a detailed exercise has to be undertaken as indicated below.

1. During the course of NI working changing of points manually after passage of a train and after completing all formalities takes about 10 minutes time.
2. The capacity of the junction station to handle maximum number of trains during a particular time period has to be worked out keeping in mind the above constraints.
3. Every possible train movement of reception and despatch must be clearly documented,
   (i) Along with time of movement.
   (ii) With exact sequence of points, whether in normal or reverse.
4. For time-tabled moves, trains demanding same point either at the same time or within 10 minutes must be identified since this is the time required before an existing setting of points can be changed. In case of conflicting moves, the less important moves have to be cancelled, rescheduled or diverted.
5. Crossing and precedence must be restricted to the bare minimum with few specific routes being selected for most movements.
6. As a thumb rule, only 80% of the reduced capacity as worked out should be utilized since unforeseen failures such as ACP, equipment failures etc. are likely to take up the remaining 20% of the available capacity.
7. In all such planning it is better to keep adequate cushion in train operations and initially cancel, reschedule or divert more number of trains than what may be required. In case NI working progresses smoothly without major detentions and it is felt that some of the cancelled trains can be restored, the same may be done after a week or so.
8. Clear corridor for freight must be charted out, with exact number of moves possible, and extra freight trains that cannot be handled should be planned to be diverted to other routes. In case diversion is not possible then operating restrictions must be imposed.
9. More time must be spent in precise planning of each move during NI period, such that the station is not brought under pressure at any time.
10. Changes in PRS reservation system for cancellation, diversion, rescheduling etc. must be done in advance as per advance period of reservation.

(D6) Advance preparation for Train

Running : Stoppages on Platform :

1. Duration of stoppages of Mail/Express trains must be reduced to the extent feasible.
2. Loading/unloading of parcels should be reduced to the bare minimum. If possible handling of parcels should be suspended giving due publicity in the Press and other media.
3. Running of trains with single SLR must be prohibited.
4. Shunting operations must be restricted to the bare minimum and preferably avoided altogether as far as possible.
5. Booking of through carriages, inspection carriages, etc. to the NI station must be restricted.
6. Quick watering of coaches must be ensured by deputing additional staff as required.
7. Nominated stations for watering of coaches may also be changed if alternate stations are available.
8. Extra TXR staff on platforms for attending to defects in rolling stock and promptly attending to complaints.

9. Extra train lighting staff must also be deputed on platform duty for promptly attending to complaints.
10. Special squads of commercial and RPF staff must be deputed on platform duty for checking ACP etc.
11. All efforts must be made to minimize detentions. Crew Changing :

1. Loco Supervisor must be kept on round the clock duty on the platform for quick change over of crews.
2. If possible crew changing for through passing trains may be planned at adjoining stations.
3. If necessary, Lis may be deputed to accompany the loco pilot from one station before NI station till one station after NI station.

4. Traffic Supervisor must be kept on round the clock duty on the platform for quick change over of guards.
5. At notice stations, computerized print out of caution orders must be used for saving time.
6. Similarly, extra porters should be deputed for delivering these caution orders to loco pilot and guard.

Locomotives :

1. Engine changing for through trains must be curtailed.
2. Locomotives must be freely extendable beyond territorial jurisdiction.
3. If it is unavoidable, then changing of locos may be done at either side of NI station.
4. For avoiding changing of locos from Diesel to Electric and vice versa, train routings may be changed during the duration of NI working.
5. For traction changing, half shunt of locos may be freely resorted to.
6. Attaching of locos in rear should be resorted to in case of stations where trains reverse.
7. Sending of light engines to sheds must be restricted. For this purpose, an out pit may be opened, if necessary.

Controlling of Trains :

1. In case of major terminal stations, a mini control office may be opened at the station. This mini control will liasion with divisional control office for purposes of train running. The jurisdiction of this mini control office would be the NI station itself, and 2 - 3 stations on either side in each direction.
2. Station under going NI must not be permitted to be brought under any pressure whatsoever at any time during NI working.
3. All relevant notices must be issued in advance. (D7) Goomty Arrangements :

Location and number of goomties is an extremely important aspect of advance planning for NI. Sr. DOM/Sr. DSO should personally approve final arrangements regarding goomties.

1. Cabins should not be used as goomties.
2. For a group of maximum of three sets of points operated from the ground, one goomty should be made.
3. Ideally, only 2 sets of points should be controlled from a single goomty.
4. Each goomty should be provided close to the group of points that it controls. This will ensure that physical movement of staff is reduced to the bare minimum.
5. A group of 3 - 4 goomties at one end of the yard should be put in one zone.
6. Under no circumstances should 2 ends of the same points/crossings be with different goomties. This must be specially ensured for diamonds with single slips and also with double slips. Each such diamond must be under the same zonal in-charge.
7. Location of each goomty as also number of points that are controlled from it should be tentatively marked out in yard diagram. This should then be physically cross checked at site by visiting the station yard.
8. At site it must be ensured that staff are not required to walk long distances for setting of points.
9. Both ends of each point must be clearly visible from the goomty itself.
10. A goomty must be provided near the first stop signal for prompt issue of OPT forms etc. as required. Another goomty must be provided at the last stop signal to ensure correct dispatch of trains.

(D8) Staff Arrangements :

Staff Requirement :

1. Each goomty should have one ASM and two Pointsman in each shift. These extra ASMs posted in goomties shall be called goomty ASMs. ASM posted with indoor ASM will be termed as co-ordinating ASM.
2. For cabin operated points, extra commensurate staff as required (ASM/cabinman/ pointsman) should be provided. However, cabins should not be used as goomties as far

as possible.

3. Goomty ASMs during their duty hours shall be fully in-charge of working of points/levers under their charge. They shall discharge all obligations of the cabinman/pointsman working at the station/cabin. They shall work under the direct supervision and instructions of the co- ordinating ASM on duty.
4. A group of four goomties or more at each end of the station should be put in one zone. Each zone should be under the charge of a TI in each shift. TI will periodically keep moving about amongst the goomties within his zone. He will check up and monitor the working of group of goomties under his charge.
5 For non-interlocking work at major terminal stations, necessary arrangement for additional staff should be made, if necessary, from adjoining divisions, before undertaking NI working.
6. Under no circumstances should NI working be started unless full complement of staff is available at the station as per above norm and adequate training has been imparted to them.

7. Preferably those staff should be drawn from outstation who have
   (i) Adequate knowledge of NI working.
   (ii) Previous experience of the same.
8. Boarding and lodging of outstation staff is an important aspect of NI preparation. Dormitory type arrangement would be ideal, if these can be arranged. At major junctions these can be taken care of by stabling a few coaches at sidings. However, facilities will have to be arranged for electrical charging, watering, cleaning of bathrooms, sanitation etc.
9. On divisions where separate non - interlocking gangs are already in existence their strength may be adjusted accordingly. However, composition of such NI gangs should be periodically changed by inducting fresh faces and with drawing earlier ones.
10. Round the clock engineering gangs with crow-bars and handles should be available to move points in emergency. One gangman should be available with each goomty in each shift for this purpose.
11. At each non-interlocked station one Asst. Scale officer of operating department will be nominated for over all supervision.

(D9) HOER :

1. Under no circumstances HOER violation should be permitted during NI working. As far as possible duty hours of staff should be restricted to 8 hrs. duty per shift in continuous roster.
2. For catering to unexpected casualties such as leave, sickness etc. during the NI period, RG and LR staff must invariably be provided for.
3. RG and LR must be made available shift wise. The standard of RG and LR should be the same as that of regular duty cadre staff for that shift as stipulated.

(D10) Duty Rosters shift wise :

Meticulous detailed planning must be carried out for drawing up roster of staff to be deputed for NI working. While drawing up roster of staff for various shift duties, following guidelines must be followed :

1. Duty rosters must be drawn up as per guidelines given below.
2. These should be drawn up for the entire duration of NI period.
3. Duty rosters drawn up should be openly displayed and given wide publicity.
4. No staff shall be permitted to mutually exchange his duty roster with any other staff, without prior permission of his departmental officer at site.
5. Level 'N + 1' shall be responsible for ensuring that level 'N' has followed all instructions, etc. as laid down above.

Last Night Shift Duty :

1. Regular staff permanently posted at the NI station must be rostered during the last night shift.
2. Second preference should be for staff who have previously worked at that station.
3. Best and most competent supervisors should be deployed for last night shift duty. First Night Shift DutV :

1. Regular staff permanently posted at the NI station, if still available for deployment after covering last night shift, should be rostered for first night shift duty.
2. Second preference should be for staff who have previously worked at that station.
3. Amongst outstation staff preference should be as follows :
   (i) Senior staff having previous experience of NI working.
   (ii) Staff who are presently posted at major junctions. Dav Shift Dutv .

1. Comparatively junior inexperienced staff from outstation should be deputed for day shift working.
2. Teams for different goomties should be so formed as to include at least one staff having previous experience of NI working.
3. For day shift working, more number of staff may be deputed per goomty, if required, to cater for comparatively inexperienced staff.

(D11) Temporary Workinq Instructions (TWI) :

1. When NI is undertaken, inter - locking provisions stipulated in SWR are no longer

available. So the SWR in its existing form becomes invalid.

2. TWI is basically meant to replace some portion of Station Working Rules of the station during the period of NI working. While they need not be as detailed as the original SWR of the station, nevertheless, they must cover all aspects of train operation that are included in the existing SWR.
3. Static information of SWR will continue to be valid. These include :
   (i) Inter - station distances.
   (ii) Description of yard layout.
   (iii) Level crossing gates.
4. TWI is to be read in conjunction with G&SR, Operating Manual, Block Working Manual. It must also be read along with existing SWR of the station.

5. Portions of SWR that will get replaced pertain to :
   (i) Ensuring clearance of running lines.
   (ii) Granting of line clear.
   (iii) Reception/despatch of trains.
   (iv) Working of level crossing gates.
   (v) All checks that are done by means of :
      (a) Slots.
      (b) Lock bars.
      (c) Point locks.
      (d) Signals.

   All these checks have to be taken care of manually.
6. TWI should list out :
   (i) Number of goomties.
   (ii) Portions of yard that each goomty would control.
   (iii) Which goomties are to be involved for reception/departure of a train on/from different lines.
7. TWI should list out different conditions required to be fulfilled for receptiondespatch of train :
   (i) How line clear is to be granted/obtained.
   (ii) How clearance of nominated line is to be ensured.
   (iii) Procedure for closure of level crossing gates, if any.
   (iv) How the route is to be set.
   (v) What are the series of points involved.
   (vi) Which one of them are to be in normal position and which ones in reverse.
   (vii) How signals are to be lowered.
   (viii) Which staff would do

what. (D12) Field level Advance Preparation :

1. Detailed working instructions clearly specifying the zone of responsibility of each and every staff and supervisor along with temporary working instructions must be issued well in advance of the NI working. In any case these should be ready at least 15 days in advance of NI workinq.
2. Station Superintendent/Traffic Inspector who is overall in-charge should be fully aware of their responsibilities/duties. Temporary working instructions should clearly stipulate these unambiguously.
3. Each Station Masters/Assist. Station Master, Cabin Man and point man deployed on shift duty should be supplied with copies of temporary working instructions. In addition SM/ASM and Cabin Man shall be supplied with yard layout diagrams and pull charts for their guidance.
4. The temporary working instruction shall be supplied to SS/ASM/Cabinman and Pointsman in advance for study by them and for explaining to illiterate staff.
5. The instruction should be prepared in Hindi, English and Vernacular language and assurance to the fact that they have understood shall be obtained.
6. Ready made pull charts indicating normal and reverse position of points for specific routes must be prepared goomty wise. All such pull charts should be prepared at least 15 days in advance.
7. TI should be entrusted with the job of personally checking each and every pull chart. Compliance report must be submitted by TI at least 10 days in advance.
8. These pull charts must be printed, laminated and displayed in goomties as also given to each staff concerned.
9. Draft instructions and pull sheets must be computerized and prepared in advance. Thereafter these should be revised on a day to day basis. Actual revision should take into account the progress of work as per the original time schedule.
10. A checklist of items to be inspected jointly by Traffic, Signal and Permanent Way Inspector should be drawn and controlling officers should monitor that instructions in the checklist are complied with.
11. The exact location on the stock rail where clamps are to be fixed must be marked with

white paint and clamps should actually be fitted to check that there are no obstructions. Clamps should be actually fitted to check that there are no obstructions.

12. It may not be possible to fix clamps on motor operated points provided with second leading stretcher bar. In all such cases provision must be made for cotter bolting of points.
13. In any case, cotter bolting of points must always be preferred as compared to clamping and padlocking since it is a much faster method.
14. Normal/reverse position of points should be painted on tongue rail to indicate position of the road.

(D13) Mock Drill and Staff Assurance :

1. Before the SM/ASM/Cabinman/Pointsman and other staff connected with train passing work are allowed independent duty, the Station Superintendent shall obtain their verbal assurance that they have understood the same.
2. With regard to semi - literate and illiterate staff :
   (i) SS/TI should explain detailed working.
   (ii) Test their knowledge.
   (iii) Satisfy himself that they can work independently.
3. Before starting actual non-interlocked working, a "mock drill" or "hands-on" demonstration/training should be given to all staff for at least 1 to 3 days in advance (depending on the size of the station) to familiarize them thoroughly with the type of work they have to handle.
4. This should be carried out in all the 3 shifts to ascertain difficulties, if any, which may be encountered during NI working.
5. Teams already formed for different shifts should be deputed as per roster.
6. "Mock drills" should be carried out without actually disconnecting signal gears, points etc.
7. Whatever deficiencies are noticed during this period should be rectified before introduction of actual NI. This experience should also be used to accurately estimate capacity to be available during N.I. and the number of trains planned to handled should be accordingly revised.
8. Written assurances are required to be obtained before staff connected with train passing duties are allowed to work independently.
9. This written assurance should be taken from the staff only after :
   (i) They have participated in the "mock drill".
   (ii) Worked independently as per their laid down roster.
   (iii) Successfully carried out all responsibilities entrusted to them during the "mock drill".
10. No staff should be deployed unless proper entries are made in the "Assurance Register" and relevant signatures obtained.

(D14) Dissemination of information :

1. All aspects of working during NI, and changes post-NI should be clearly documented and explained at all Loco pilot/Guard lobbies, whose staff pass through that yard.
2. For this purpose loco/traffic inspectors, senior subordinates will be nominated to visit these lobbies, with yard plans and camp at these lobbies.
3. Assurance of each and every running staff regarding these changes should be recorded in respective lobby assurance registers, and complete report submitted to Sr. DOM/Sr. DSO/Sr. DME/Sr. DEE on return.
4. Adjoining divisions/railways including notice stations and inter-change points should also be intimated of the detailed program pertaining to NI working.
5. All control staff including CHC, Dy. CHC, Section controllers, Power controllers, TLCs, TXR control etc. should be appropriately briefed.
6. The section controllers working on control boards must be fully conversant with the proposed changes pre-NI, restricted movement during the course of NI working and post-NI facilities to be made available.
7. Adequate publicity must be given through newspaper advertisements, electronic media, announcements at stations etc. informing the public of the likely repercussions on train running.

(D15) Telecommunication, Lighting and Medical :

1. Absolutely foolproof arrangements must be made regarding communication between the station and two adjoining stations on either side so that under no circumstances should there be a situation of total failure of communication between these stations.
2. Satisfactory arrangements for telephonic communication between station (indoor), Cabins, Goomty and Level Crossings Gates should be made to ensure efficient

functioning of telephones provided at various locations.

3. Additional fail safe communication between control office and the NI station must be provided as a backup to existing section control channels.
4. Arrangements for public address system should also be made so that the same can be used for warning the public etc.
5. Loud speakers must be provided on each goomty for making announcements regarding train movement.
6. Walkie - Talkie sets must be provided to all supervisors working at site.
7. Gangmen, Keymen and Patrolmen in 2 block sections on either side of the NI station must be provided with walkie - talkie sets, electronic hand signal lamps etc.

8. Arrangements of staff and recharging facilities should be available for charging of batteries of telecom equipment including walkie - talkies.
9. General lighting in yard should be adequate.
10. Separate lighting should be provided in each point zone. Lighting should be adequate so as to ensure that each point controlled from a goomty is clearly visible to the ASM/Cabinman in charge of that goomty.
11. Adequate generator backup should be provided. Spare bulbs should also be provided at each location.
12. Round-the-clock medical post with doctor and para-medical staff must be provided. They should be equipped for handling first aid and crush injuries. Anti-snake venom (Covalent) should be available. Road ambulance should be permanently stationed for quick transportation if needed.

(D16) Safety Equipment :

1. Safety equipment required for each location such as goomty, cabin, level crossing gate etc. must be spelt out in detail and full complement arranged.
2. Adequate spares must be arranged for safety equipment such as of hand signal flags, detonators, fusees, clamps and pad locks etc.
3. LED based flashing Hand Signal Lamp must be provided to each such location for better visibility.
4. Cotter bolts, cotter pins and clamps & padlocks must be thoroughly tested to be in proper working condition.
5. Spare numbered crank handles must be provided in goomties where point machines are pre- dominantly working.
6. Each goomty must be provided with the following safety equipment :
   (i) Clamps, padlocks, detonators, fusees.
   (ii) Flags, hand signal lamps etc.
   (iii) Relevant pull sheets, yard diagrams etc. duly laminated.
   (iv) Torches, emergency light, in addition to normal lighting.
   (v) Umbrellas, caps, raincoats as required.
   (vi) Cotton Gloves for staff handling points etc.
   (vii) Table, chairs in tent or covered area.
   (viii) Containers and glasses for drinking water.
   (ix) Thermos for tea/coffee and provision of snacks and meals for staff deployed from other station or /headquarters.
   (x) Mosquito/insect repellant creams.
   (xi) Magnetto, and VHF walkie talkies, Public Address Equipment.
   (xii) Private number books, paper, pens.

(D17) Security arrangements :

1. Adequate RPF security staff round the clock must be arranged at following locations :
   (i) ASM's office.
   (ii) Central place at the station.
   (iii) Level crossing gates.
   (iv) Outer most goomties on either end.

(D18) Introduction of NI working :

1. Before permitting introduction of NI working DRM/ADRM will satisfy himself regarding arrangement of staff, safety equipment, lighting, telecommunication and ground position.
2. On the day of commencement of NI working, branch officers concerned from Operating/Safety, Engineering, Signal, Electrical and Mechanical along with DRM/ADRM will visit the place of work. They shall satisfy themselves of availability of necessary arrangement as per standard before permitting introduction of non-interlocking.

3. On the notified day, for introduction of NI working, Signal Inspector concerned shall give a general disconnection memo for gears proposed for NI workinng.

(D19) Train Operation during NI period : Workinq of Signals :

1. Speed restriction of 15 kmph. must be in force over all points and crossings. Speed restriction Board of 15 kmph. must be exhibited at the foot of the first stop signal.
2. The following signals should be provided with caution aspect :
   (i) In case of colour light signals, a common NI home signal without route indicator.
   (ii) In case of MAUQ/TALQ, single arm NI home signal.
   (iii) Warner signals, if any are to be put out of commission by putting 2 cross bars.

3. NI Home/Starter signal can be taken off only after ensuring that :
   (i) All points on the route are correctly set, both facing and trailing points clamped and padlocked.
   (ii) In addition to correct setting, clamping and padlocking of facing points, they must also be manned.
   (iii) Level crossing gates on the route have been closed against road traffic.
4. Last stop signal should not be disconnected throughout NI working except at the fag end.
5. Movement of trains to and from the block sections should be controlled by taking off the last stop signal.
6. Normally, no Paper Line Clear should be issued to the loco pilots as authority to proceed in the block section.
7. A traffic block of 2 - 3 hrs. should be taken for disconnecting the last stop signal and block instrument and reconnecting the new last stop signal and new block instrument.

Train Running

1. Each train movement must be announced well in advance on the loudspeaker:
   (i) Along with the number of the goomty involved.
   (ii) Sequence of points required to be set and locked in normal or reverse condition.
2. Trains must be allowed to enter cautiously at 15 kmph.
3. Loco pilot of an incoming train must not under any circumstances pass the outermost facing points even though signals have been taken off:
   (i) Unless he also sees that the points are manned.
   (ii) A proceed hand signal is exhibited towards him from the

points. (D20) Failures :

1. All indicative accidents during the period of NI working must be immediately reported to the site in charge in order to ensure prompt corrective action and avoidance in future.
2. Details regarding such cases must be promptly intimated to DRM and Sr. DSO.
3. A register must be opened at each goomty in which before handing over charge, staff will enter details of whatever difficulties they have faced during their shift. The person in charge of NI working at that station must scrutinize this register daily.
4. Cases of bursting of NI target should be appropriately dealt with and individual responsibility should be fixed up.

(D21) Revised Station Working Rules :

1. After completion of NI working, new works are to be commissioned.
2. Since the yard layout, facilities etc. have changed, the previous SWR is no longer valid.
3. A new SWR duly approved by CRS is to be brought into effect after completion of NI.
4. Staff assurances for the revised SWR must be taken

afresh. (D22) Completion of NI Working:

1. NI working must not be terminated unless and until each and every item originally scheduled for completion has been successfully complied with.
2. Designated operating officer must visit the NI station and verify the following:
   (i) Completion of work as per program.
   (ii) Correspondence of yard layout as per SWR.
   (iii) Correspondence of movements permitted as per SWR.
3. The installation shall jointly be tested by Traffic, S&T and Engg. officials and for their correct functioning.
   (i) The lever/knobs, signals, points and connections work freely and properly and that the installation fulfils its objective.
   (ii) Signals are properly focussed, the indications on the panel correspond with the signal aspect and point position at site.

(iii) Engineering officials shall check the proper housing of points gauge level etc.

4. Before issue of Safety certificate and taking over of stations, the Transportation/Safety Officer shall instruct the station staff responsible or working the interlocking installation and test them in their knowledge of the signalling arrangement.

5. Engineering and S&T officers shall give a certificate stating that all works as per the approved plan are completed.

6. Staff concerned shall be notified through Station Order Book, Control Order Book and their acknowledgement obtained. All inspectors and other supervisors shall ensure strict compliance and report any deviation or violation with prompt to notify then and there.

7. On the day of completion of work, branch officers concerned shall visit the work site to ensure completion of work as per program.

(D23) Post NI analysis :

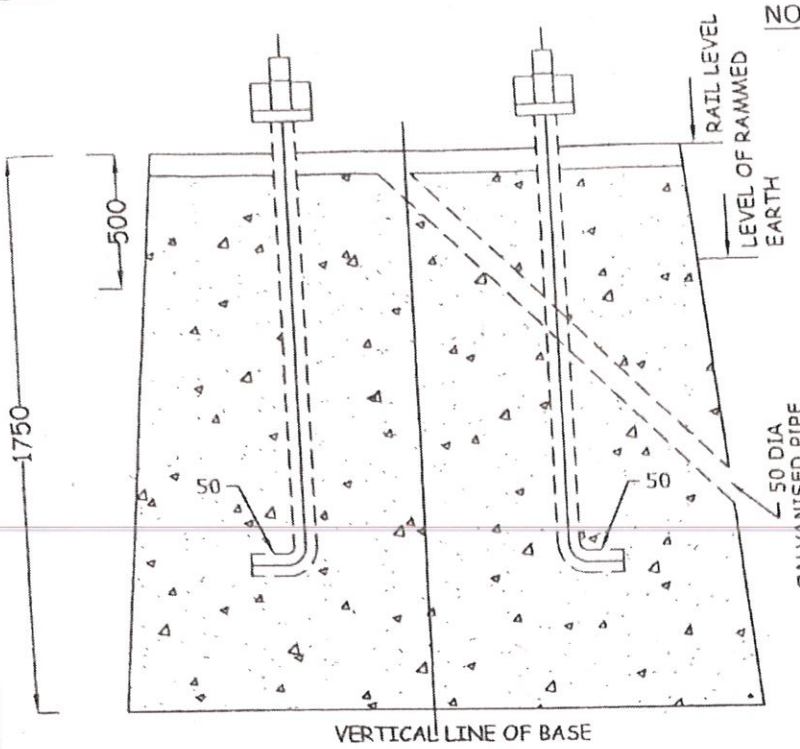
1. Within 7 days of completion of NI, a brain storming session should be held with all the senior supervisors involved for taking stock of lessons learnt.
2. These lessons learnt should be compiled at one place for successive Nls, so that they are available for future reference.

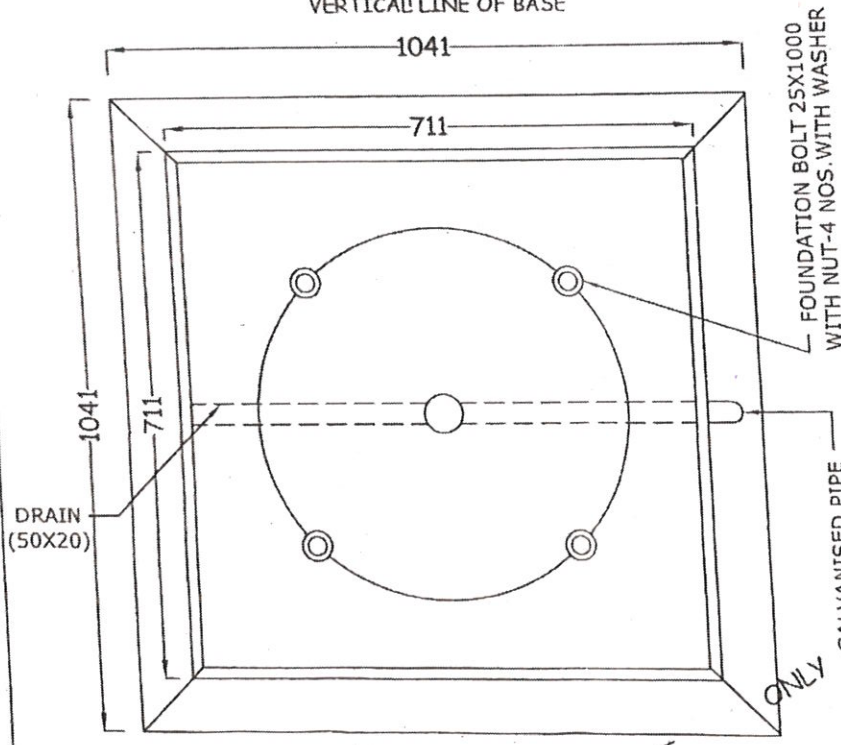
A copy of the same may also be sent to other divisions for reference purposes.

(End of Appendix-4)

Appendix -5 to Section 5-2 PS (Signalling)

Deleted





NOTE:-

1 CASTING OF BOLTS TO BE DONE IN THE CONCRETE BASE DULY TAKING THE MEASUREMENTS OF THE SURFACE BASE AND CIRCLE ALSO ALIGNING THE FOUR HOLES OF THE SURFACE BASE WITH THE BOLT LOCATION 1,2,3 & 4 BY PROYING TEMPLATE.

2 ENTIRE FOUNDATION SHOULD BE CAST IN ONE STRETCH AND WITH BOLT ONLY.

3 DRAIN ON SURFACE OF THE FOUNDATION SHOULD HAVE ENOUGH SLOPE FOR DRAINING OUT OF ANY WATER.

4 50 DIAMETER G.I. PIPE TO BE EMBEDDED DURING CASTING IT SELF.(AND NOT LATER ON)

5 AFTER CASTING OF BASE AND CURING OF THE SAME IS OVER THE FOUR SIDES OF THE BASE TO BE CLEARED OF ALL LEFT OVER CONCRETE AND SIDES DULY RAMMED WITH EARTH UP TO 500 BELOW THE TOP OF THE BASE.

6 WHERE REQUIRED PITCHING ON THE RELEVENT SIDES OF THE RAMMED SURFACE WITH 225 TO 300 SIZE BOULDERS SHALL BE DONE & FILLING THE CREVICES WITH 1:6:12 CONCRETE WITH FINE 20 STONE CHIPS PITCHING WILL BE TO THE FULL HEIGHT OF THE RAMMED EARTH.

7 OUTER SURFACE SHOULD BE PLASTERED FROM TOP OF FOUDATION WITH 1:2 CEMENT SAND UP TO A LEVEL OF 50 BELOW.

8 FOUNDATION WITH MIXTURE OF CEMENT,SAND AND STONE CHIPS SIZE-25 (1:3:6)

9 ALL DIMENSIONS ARE IN MM.

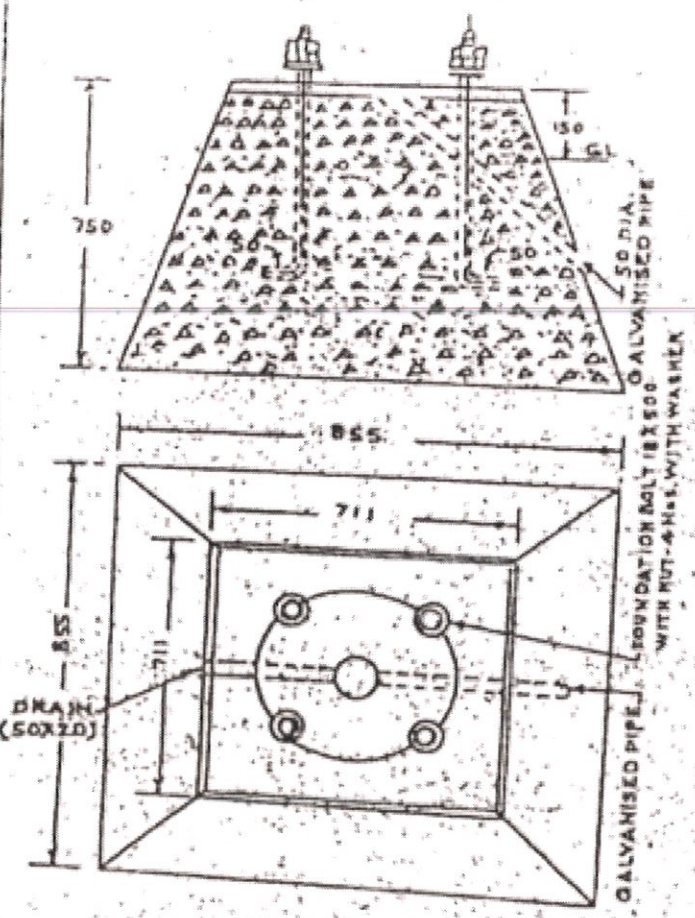
ONLY

OF LDH PROJECT

NOT TO SCALE

NR	SIGNAL FOUNDATION FOR CA-59	SSE/D&D/LDH 19/02/19	AESTE/W/LDH 19/2/19	DY.CSTE/W/LDH 19/2/19	Drawing No. NR/S&T/CON/2.1/97

N.Rly.



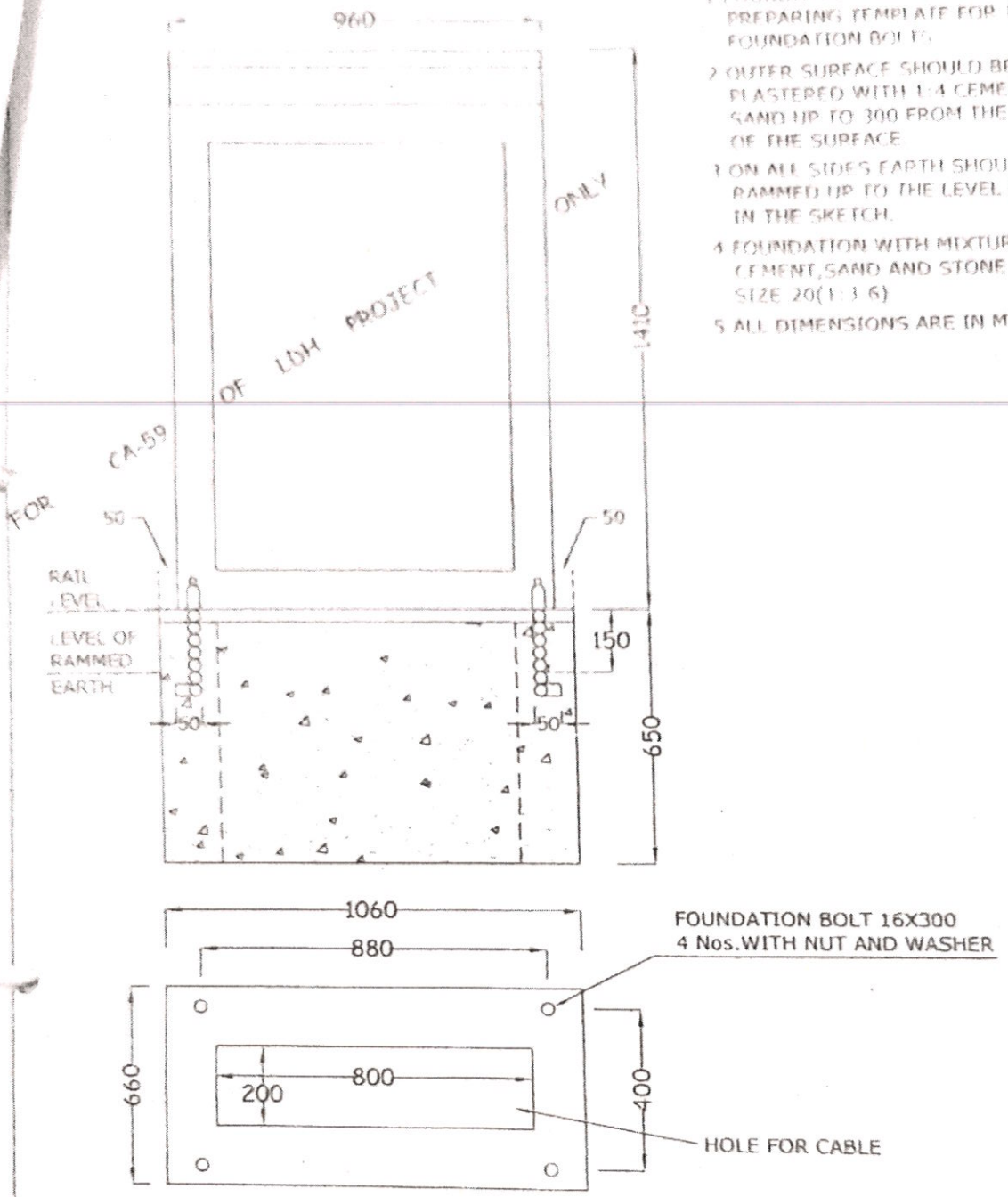
NOTE:—

1. CASTING OF BOLTS TO BE DONE IN THE CONCRETE BASE DULY TAKING THE MEASUREMENTS OF THE SURFACE BASE AND CIRCLE ALSO ALIGNING THE FOUR HOLES OF THE SURFACE BASE WITH THE BOLT LOCATION 1, 2, 3 & 4 BY PROVING TEMPLATE.
2. ENTIRE FOUNDATION SHOULD BE CAST IN ONE STRETCH AND WITH BOLT ONLY.
3. DRAIN ON SURFACE OF THE FOUNDATION SHOULD HAVE ENOUGH SLOPE FOR DRAINING OUT OF ANY WATER.
4. 50 DIAMETER G.I. PIPE TO BE EMBEDDED DURING CASTING ITSELF. (AND NOT LATER ON)
5. OUTER SURFACE SHOULD BE PLASTERED WITH 1:4 CEMENT SAND UPTO A LEVEL OF 100 FROM GROUND LEVEL.
6. FOUNDATION WITH MIXTURE OF CEMENT, SAND AND STONE CHIPS OF SIZE 25 (1:3:6)
7. ALL DIMENSIONS IN MM.

			S.E./D&D/LDH		
N. R.	SHUNT SIGNAL FOUNDATION				No NR/S&T/CON/2-1/97-A
	NOT TO SCALE		S.E/C	SSTE/C/LDH	

NOTE :

1. FOUNDATION SHOULD BE CAST PREPARING TEMPLATE FOR THE FOUNDATION BOLTS.
2. OUTER SURFACE SHOULD BE PLASTERED WITH 1:4 CEMENT SAND UP TO 300 FROM THE TOP OF THE SURFACE.
3. ON ALL SIDES EARTH SHOULD BE RAMMED UP TO THE LEVEL SHOWN IN THE SKETCH.
4. FOUNDATION WITH MIXTURE OF CEMENT, SAND AND STONE CHIPS SIZE 20(1:3:6)
5. ALL DIMENSIONS ARE IN MM.

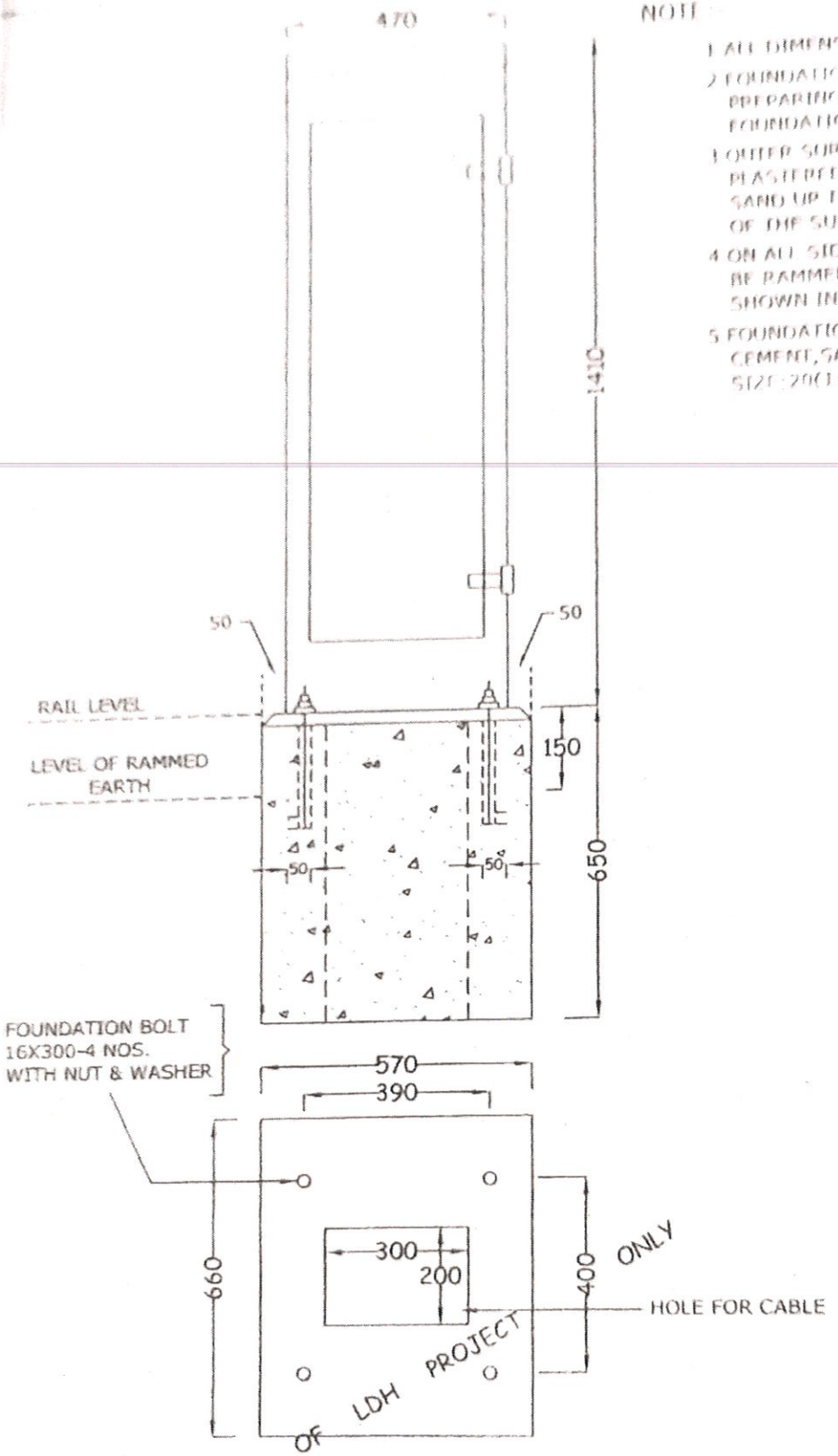


N.R.	FOUNDATION FOR APP.CASE SINGLE				N.R/S&T/CON/2.7/97
	NOT TO SCALE	SSE/D&D/LDH	AESTE/W/LDH	DY.CSTE/W/LDH	

N.Rly.

NOTE

1 ALL DIMENSIONS ARE IN MM.
2 FOUNDATION SHOULD BE CAST BY PREPARING TEMPLATE FOR THE FOUNDATION BOLTS.
3 OUTER SURFACE SHOULD BE PLASTERED WITH 1:4 CEMENT SAND UP TO 300 FROM THE TOP OF THE SURFACE.
4 ON ALL SIDES EARTH SHOULD BE RAMMED UP TO THE LEVEL SHOWN IN THE SKETCH.
5 FOUNDATION WITH MIXTURE OF CEMENT, SAND AND STONE CHIPS. SIZE : 20(1:3:6)

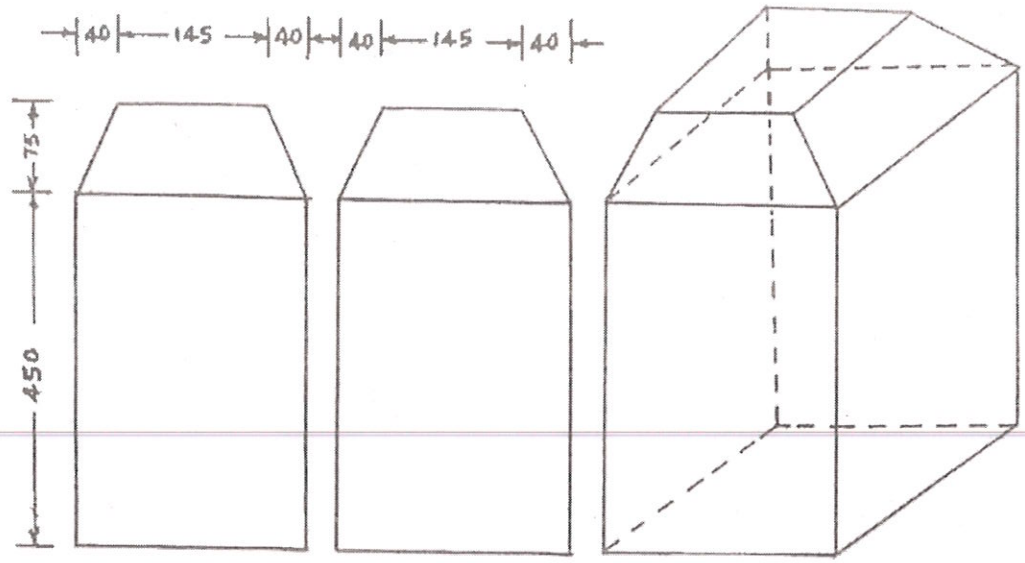


FOR CA-59

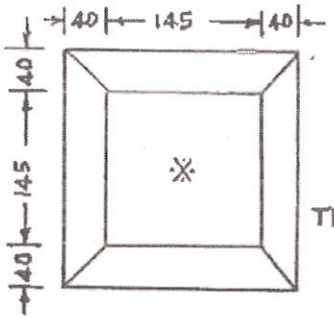
N.R.	FOUNDATION FOR APP.CASE HALF				NR/S&T/CON/2.8/97
	NOT TO SCALE	SSE/DSO/LDH	AESTE/W/LDH	DY.CSTE/W/LDH	

2ly.

6



FRONT ELEVATION SIDE ELEVATION 3-DIMENSION VIEW



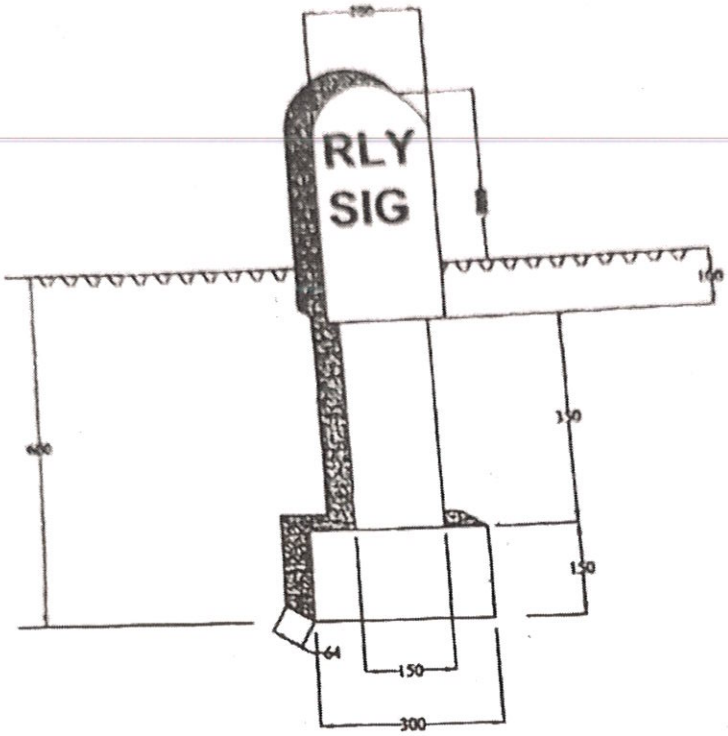
※
SIG: CABLE
OR
TELECOM: CABLE

NOTE:-

1 DIMENSIONS ARE IN MILLIMETERS.
2 CABLE MARKER IS TO BE MADE FROM 1:3:6 CEMENT, SAND, COARSE & CONCRETE MIXTURE.
3 ENGRAVATION IS TO BE MADE AS PER THE TYPE OF CABLE AT SITE.

			S.E/D.& D/L'DH		
N.R.	CABLE MARKER FOR SIG. & TELECOM:CABLE	N. Mahadi			Nº NR/S&T/CON/1-5/97-A
	NOT TO SCALE	DRN.	S.E/C	ASTE/SPL	

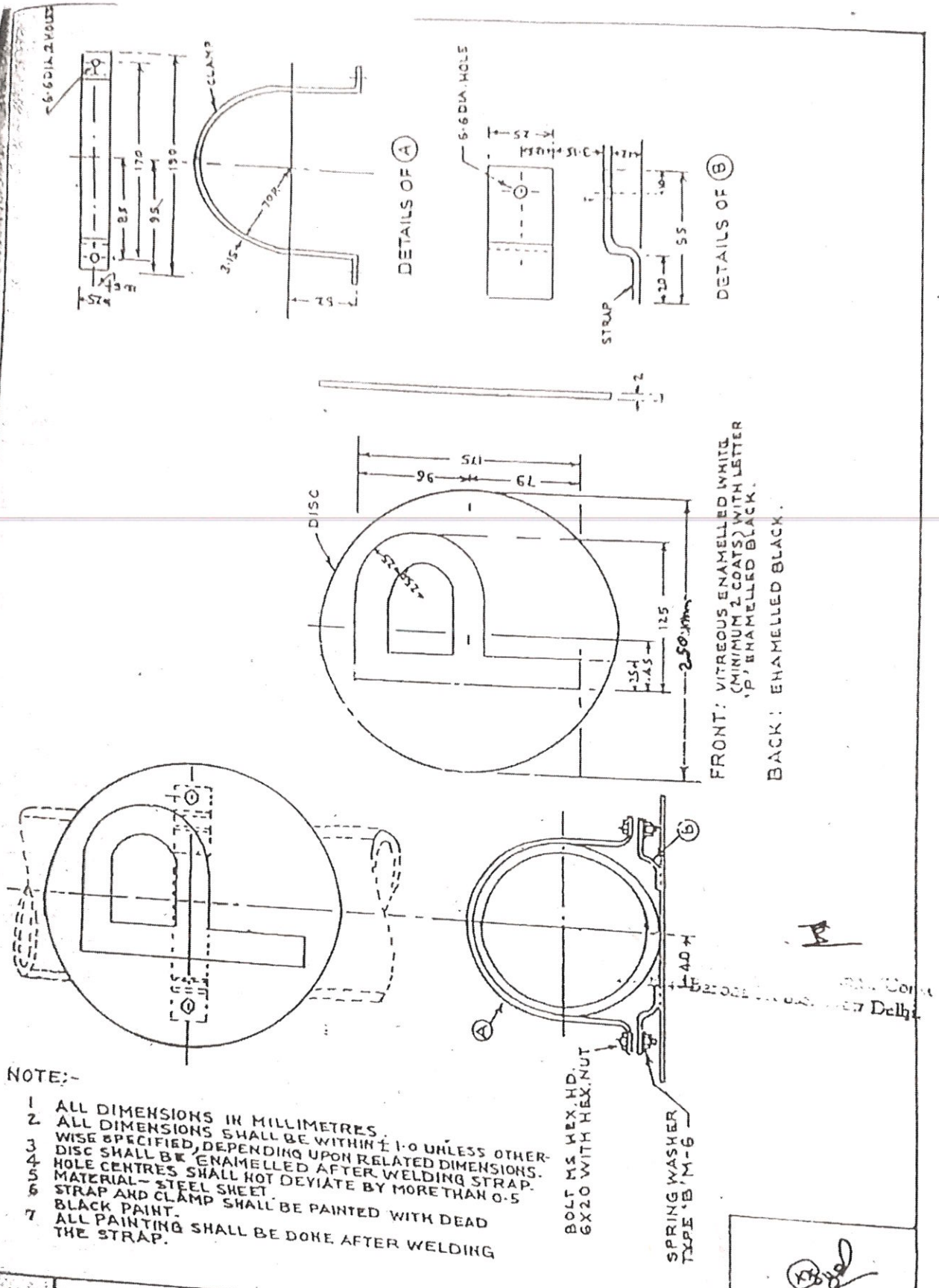
Annexure-23



NOTE:-

1. ALL DIMENTIONS ARE IN MILLIMETER
2. PAINTED WHITE LETTERS ON RED BACKGROUND.
3. FOUNDATION CONCRETE OF 300 mm FROM THE BASE OF THE MARKER SHALL BE DONE AT SITE AT ALL PLACES WITH MIX 1:3:6.
4. COMPONENT CONCRETE SHALL BE OF M25 MIX AND WIRE MESH OF 1.5MM THICKNESS SHALL BE USED.
5. THE ENGRAVING OF "RLY" & "SIG" SHALL BE DONE ON BOTH SIDES OF THE MARKER.

CHECKED BY	JE/SE/SSE	CONCRETE CABLE MARKER	SDO/CABLE LAYING/020
APPROVED BY	ADE	R.D.S.O.	DATE :- 31-10-2011
NOT TO SCALE			



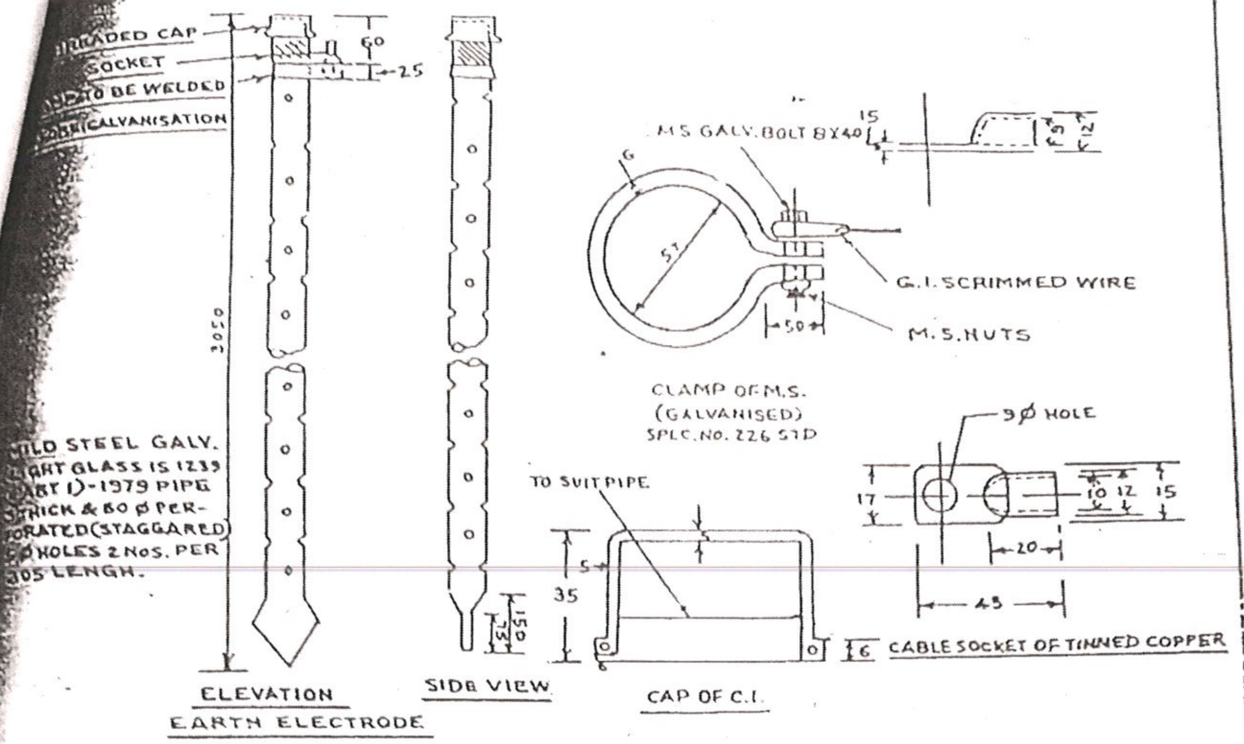
NOTE:-

1. ALL DIMENSIONS IN MILLIMETRES.
2. ALL DIMENSIONS SHALL BE WITHIN ± 1·0 UNLESS OTHERWISE SPECIFIED, DEPENDING UPON RELATED DIMENSIONS.
3. DISC SHALL BE ENAMELLED AFTER WELDING STRAP.
4. HOLE CENTRES SHALL NOT DEVIATE BY MORE THAN 0·5
5. MATERIAL – STEEL SHEET.
6. STRAP AND CLAMP SHALL BE PAINTED WITH DEAD BLACK PAINT.
7. ALL PAINTING SHALL BE DONE AFTER WELDING THE STRAP.

S.E/D & D/LDH

N.R.	'P' MARKER NON ILLUMINATED				Nº N R/S&T/CON/6-2/97
	NOT TO SCALE	DRN	SE/C	ASTE/SPL	

By KHANDELWAL ELECTRIC



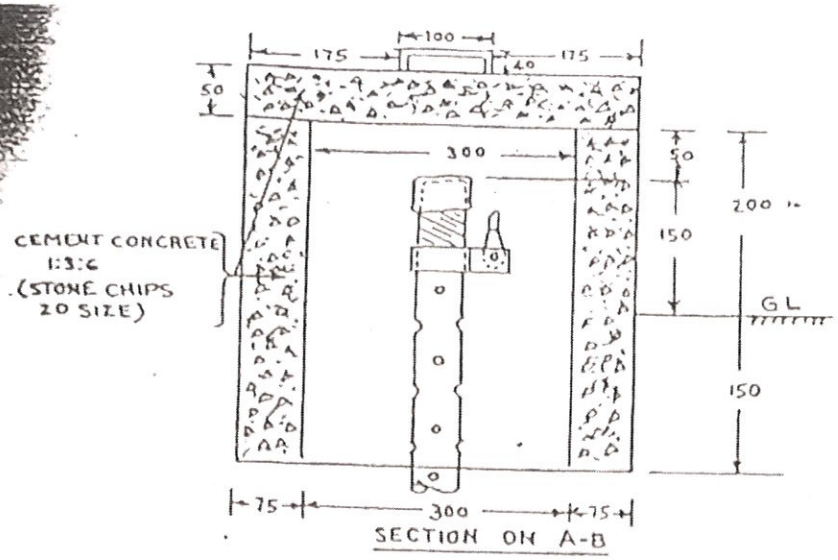
NOTE :-

1. ALL DIMENSIONS IN MM.
2. NOT TO SCALE
3. LOWER END OF PIPE TO BE SHAPPED AS SHOWN BY SQUIZZING & IF NECESSARY BY CUTTING OF DEFORMED MATERIAL.
4. EARTH ELECTRODE PIPE TO BE GALVANISED AFTER DRILLING AND FABRICATION.
5. EACH ELECTRODE SHOULD BE SUPPLIED WITH A GALVANISED HEX-HEAD IRON BOLT TO SPEC. No. I.S. 1821-1961 (8 ø, 40 LENGTH WITH 25 THREADED PORTION) AND TWO ROUND FLAT WASHERS AND A NUT TO SUIT FOR FIXING THE SOCKET TO PIPE CLAMP.

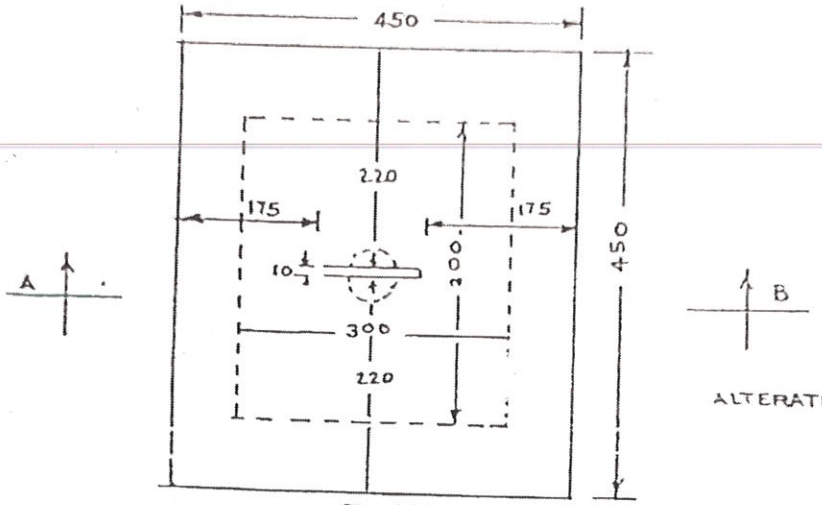
Engr./Cons. ... Delhi.

S.E./D & D/LDH

N.R.	EARTH ELECTRODE (G.I. PIPE)				No. N R/S&T/CON/6-3/97
	NANDLAL ELECTRICALS	DRN.	S.E./C	ASTE/SPL	



SECTION ON A-B



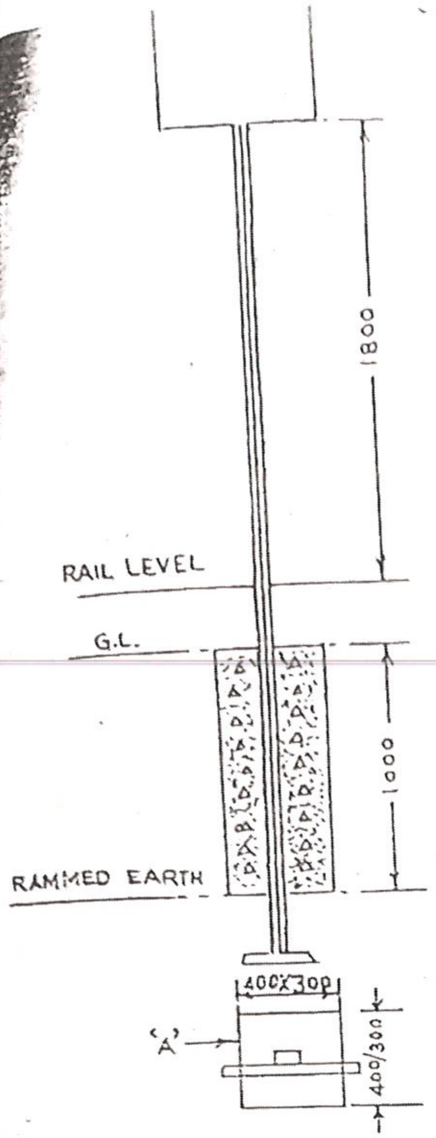
PLAN

ALTERATION (A) COVER PROVIDED

NOTE:-

1. OUTER SURFACE ABOVE GROUND LEVEL SHOULD BE PLASTERED WITH 1: 4 CEMENT SAND.
2. ALL DIMENSIONS IN mm.

			SE/O & D/LDH		
N.R.	C.C: ENCLOSURE EARTH ELECTRODE AND HANDLE				No NR/S&T/CON/ 6·4/97
	NOT TO SCALE For KHANDELWAL ELECTRICALS	DRN.	SE/C	ASTE/SPL	



NOTE :-

1. IN CASE CHANNEL POST IS USED THE DIMENSIONS OF 'A' WILL BE 300 AND IF RAIL POST IS USED THE DIMENSION OF 'A' WILL BE 400
2. FOUNDATION WITH MIXTURE OF CEMENT, SAND AND STONE CHIPS SIZE-20 (1:3:6)
3. ALL DIMENSIONS IN MM.

Asstt. & Telecomn. Engr./Constr

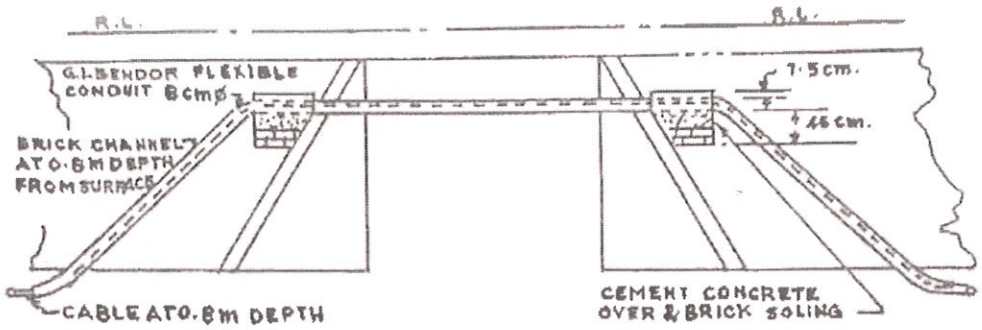
S.E/D&D/LDH

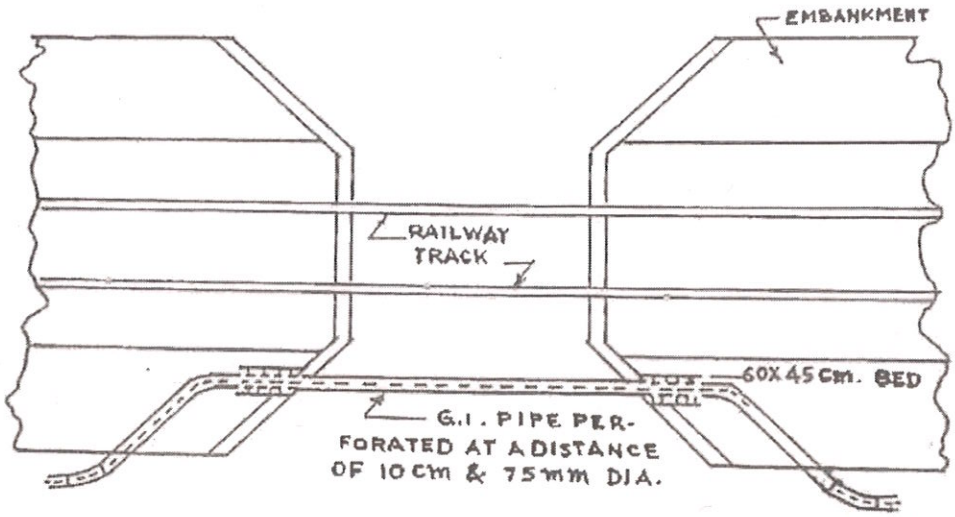
N.R.	FOUNDATION FOR BLOCK SECTION LIMIT BOARD SHUNTING LIMIT BOARD SIGHTING BOARD				№ NR/S&T/CON/ 7.4/97
	NOT TO SCALE	DRN.	SE/C	ASTE/SPL	

For KHANDELWAL ELECTRICALS

12

5

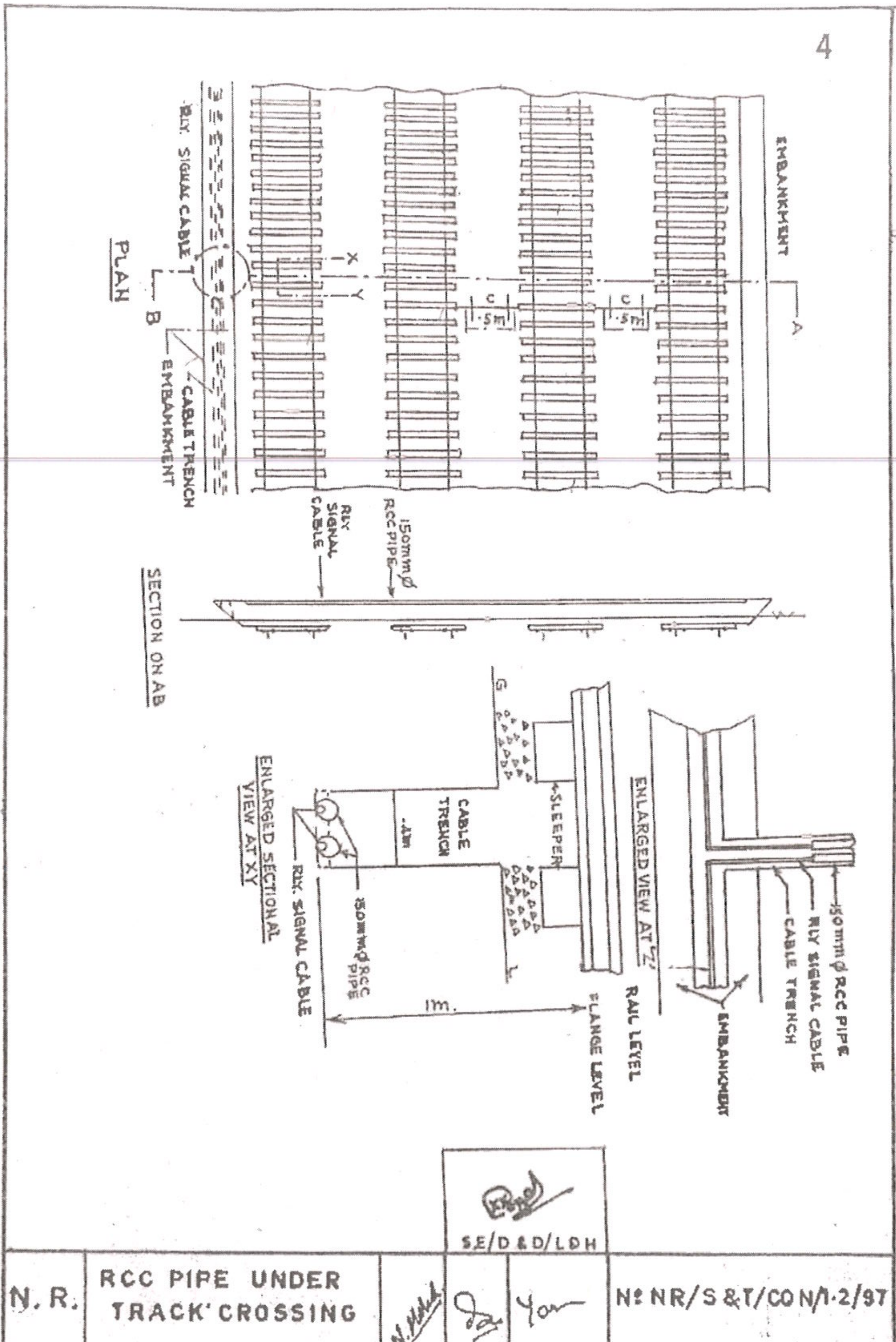




SE/D&D/LDH

N. R.	G.I. PIPE ON CULVERT				No NR/S&T/CON/1.4/97
	NOT TO SCALE	DRN.	SE/C	ASTE/SPL	

7

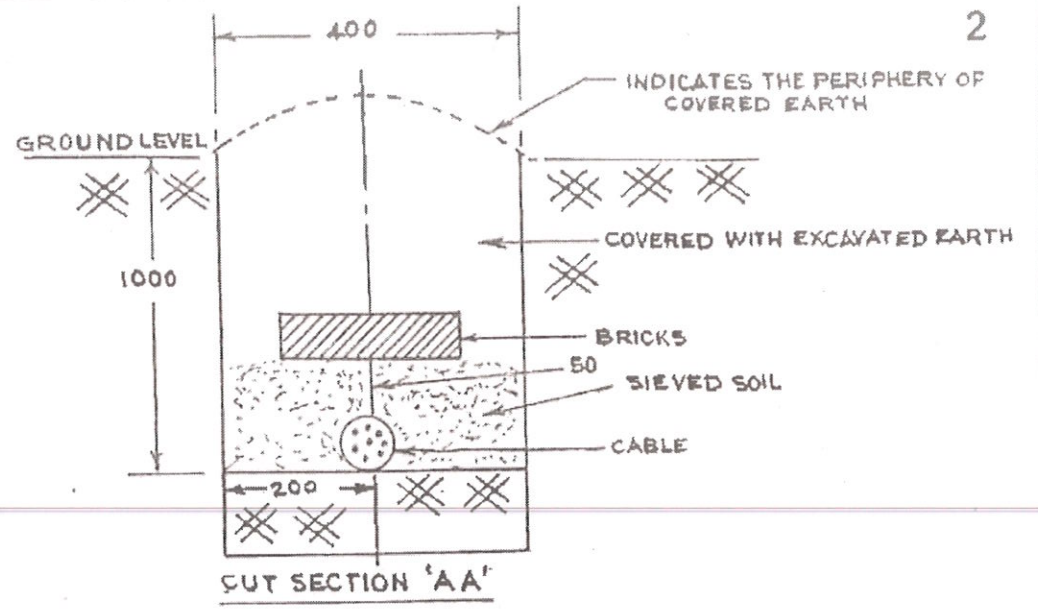


SE/D&D/LDH

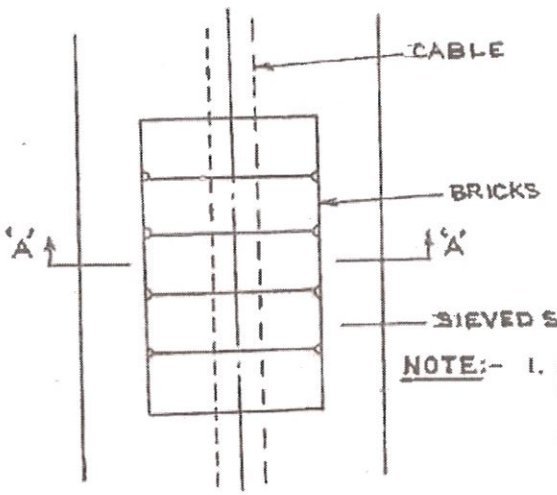
N. R.	RCC PIPE UNDER TRACK CROSSING				No NR/S&T/CON/1-2/97
	NOT TO SCALE	DRN.	SE/C	ASTE/SPL	

6

2



CUT SECTION 'AA'



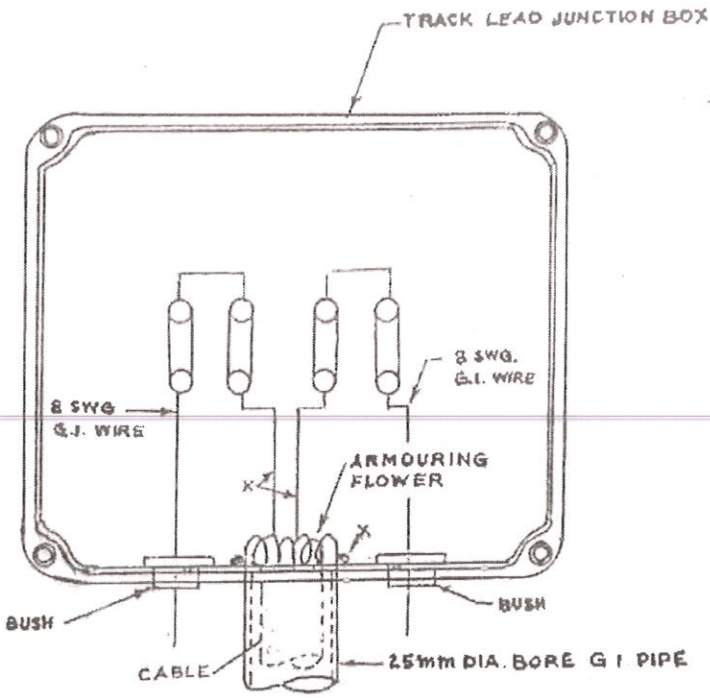
PLAN VIEW

NOTE:-
1. CABLE MARKERS SHALL BURRIED ALONG THE CENTRE LINE OF TRENCH AT EVERY 30 METRES AND ALSO ON DIVERSIONS AND CROSSINGS AND THE MARKER FACE SHALL BE100 ABOVE GROUND LEVEL.
2. ALL DIMENSIONS IN mm.

			SE&D/L DH		
N.R.	CABLE TRENCH				No NR/S&T/CON/11/97-A
	NOT TO SCALE	DRN.	SE/C	ASTE/SPL	

5

12



X 1X2C 2·5 Sq.mm. CABLE

NOTE :-

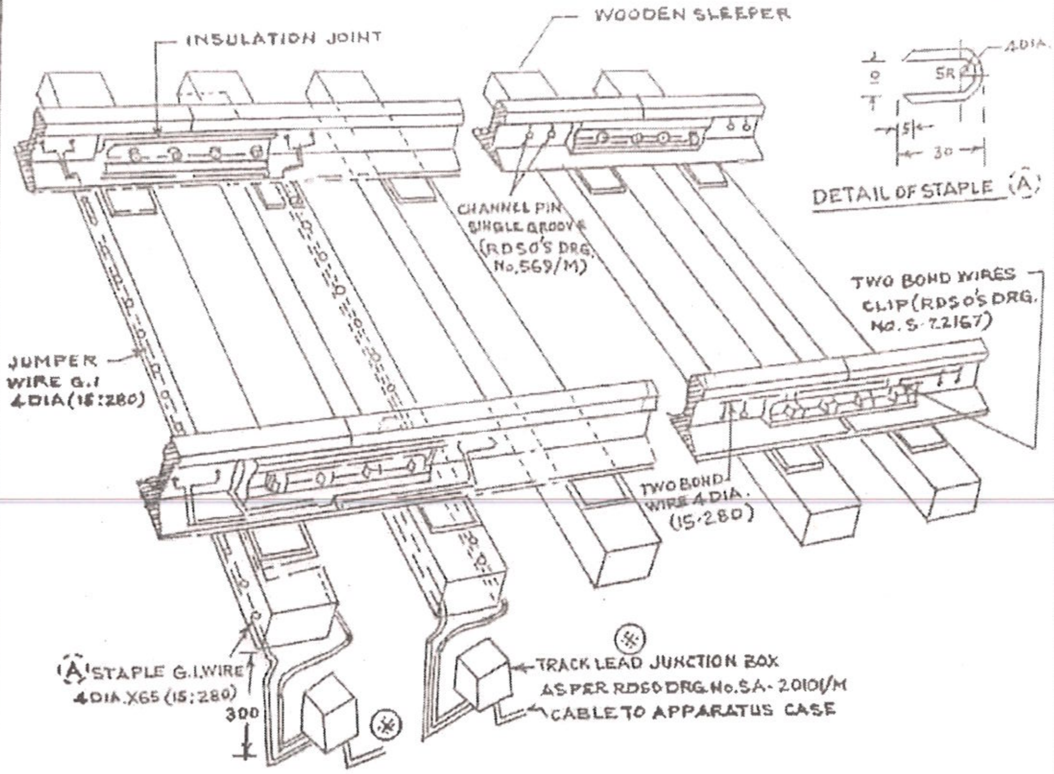
1 ALL DIMENSIONS IN MM.

2 ARMOURING FLOWER PROVIDED FOR PREVENTING THE PULLING OUT OF THE CABLE FROM TRACK LEAD JUNCTION BOX.

3 NYLON BUSH TO BE PROVIDED TO PREVENT EARTHING OF G.I. JUMPER WIRE.

X 4 HEXAGON BACK NUT M.S. FOR 25 DIA. ANNODISED BORE.

			S.E/D&D/LDH		
N. R.	CABLE TERMINATION ARRANGEMENT IN TRACK LEAD JUNCTION BOX				No NR/S&T/CON/32/37
	NOT TO SCALE	DRN	SE/C	ASTE/SPL	



NOTE:-

1. JUMPER WIRES WILL BE TAKEN THROUGH TRANSPARENT PVC PIPE OF GOOD QUALITY TO AVOID EARTHING OF POSITIVE RAIL.
2. THE G.I. JUMPER WIRE WILL BE TAKEN TO TRACK LEAD JUNCTION BOX THROUGH INSULATED NYLON BUSH PROVIDED IN TRACK LEAD. JUNCTION BOX SEPERATLY FOR +VE AND NEGATIVE RAIL.
3. THE TRACK LEAD J.B. SHOULD BE PROVIDED AT A LEVEL SUITING G.I. JUMPER WIRE AND AVOID INFRINGEMENT. THE J.B. SHOULD CLOSE TO SLEEPER TO AVOID DAMAGE.
4. STAPLES SHOULD BE PROVIDED FOR SUPPORTING THE WIRE WITH WOODEN SLEEPERS AT SUITABLE DISTANCE.
5. INVARIABLY BOND WIRE CLIPS MUST BE PROVIDED FOR THROUGH BOND WIRE.
6. JUMPER WIRE SHOULD BE SECURED BY TWO Nos. OF CHANNEL PIN AT INSULATED JOINTS FOR BETTER CONTACT.
7. CABLE SHOULD BE PROPERLY SECURED IN TRACK LEAD JUNCTION BOX BY PROVIDING FLOWER MADE OF CABLE ARMOURING.

				SE/D&D/LDH	
NR	TRACK CIRCUIT CONNECTION JUMPER WIRE & BOND WIRE FIXING IN TRACK LEAD JN: BOX ON WOODEN SLEEPER				No NR/S&T/CON/ 3.1/97
	NOT TO SCALE	DRN.	SE/C	ASTE/SPL	

APPENDIX-7

List of Dismantling Signalling Gears

Station: Patli (Delhi End)

A) Full Location Boxes:
   1) L-3
   2) L-3A
   3) L-12
   4) B/Box
   5) L-12C

B) Half Location Boxes:
   1) L-1
   2) L-2
   3) B/Box
   4) B/Box
   5) B/Box
   6) L-12A
   7) L-12D

C) Signal:
   1) SA1
   2) S1
   3) S34
   4) S31
   5) S2

D) Point Machines:
   1) 64A
   2) 64B
   3) 63a

APPENDIX-8

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.

APPENDIX-8

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 belowj,*

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 belowj* 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

APPENDIX-8

‘Authorized

Representative’(for

Designer)

Name

Position/ Designation

Date

APPENDIX-8

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

Positi

on/D

esign

ation

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:

Note 2

The Contractor designer/authorized representative shall take utmost care while signing the Design certificate. For repeated false compliance of specifications/Work's requirement, Engineer may ask for suitable replacement for the position.

APPENDIX-8

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 thisSubmission 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

Section C

[Contractor to attach copies of necessary and required approvals)

(End)

Appendix 9 to Section 5-2 PS (Signalling)

REV:	DATE	REMARKS
A	03-02-2023	DEVELOPED
B	07-02-2022	FORMATTING AS NR PATLI EXISTING SIP
C	11-02-2023	FORMATTING AS NR PATLI EXISTING
D	14-02-2023	FORMATTING AS NR PATLI EXISTING
E	16-03-2023	Signal Aspects
F	22-03-2023	DELHI END
G	05-04-2023	DELHI END
H	06-04-2023	DELHI & REWARI END

HRIDC		GC/HORC	
CPM		PD	
DGM	18/4/23	DPD/ES&T	06/04/23
AM/S&T	17/04/2023	CRE/S&T	06-04-2023
		SE/S&T	06/04/2023

NORTHERN RAILWAY

DELHI DIVISION

PROJECT: HARYANA ORBITAL RAIL CORRIDOR

CONNECTING PALWAL TO SONIPAT BYPASSING DELHI AREA BY LINKING ASAOTI-PATLI-SULTANPUR-ASAUDAH BY NEW ELECTRIFIED BG DOUBLE LINE

CLIENT: HARYANA RAIL INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED.

DRG. NO:- GC-HRIDC-PATLI(S&T)-DRW-SIP-001-A0

REV: H DATE: 06-04-2023

DRAWING NAME: SIGNALLING INTERLOCKING PLAN PATLI STATION (ELECTRONIC INTERLOCKING)

CLASS-'B' STANDARD OF INTERLOCKING- II(R)

SCALE: HORIZONTAL: 1:1000 1MM:1METRE; VERTICAL: 1:500 1MM:0.5 METRE

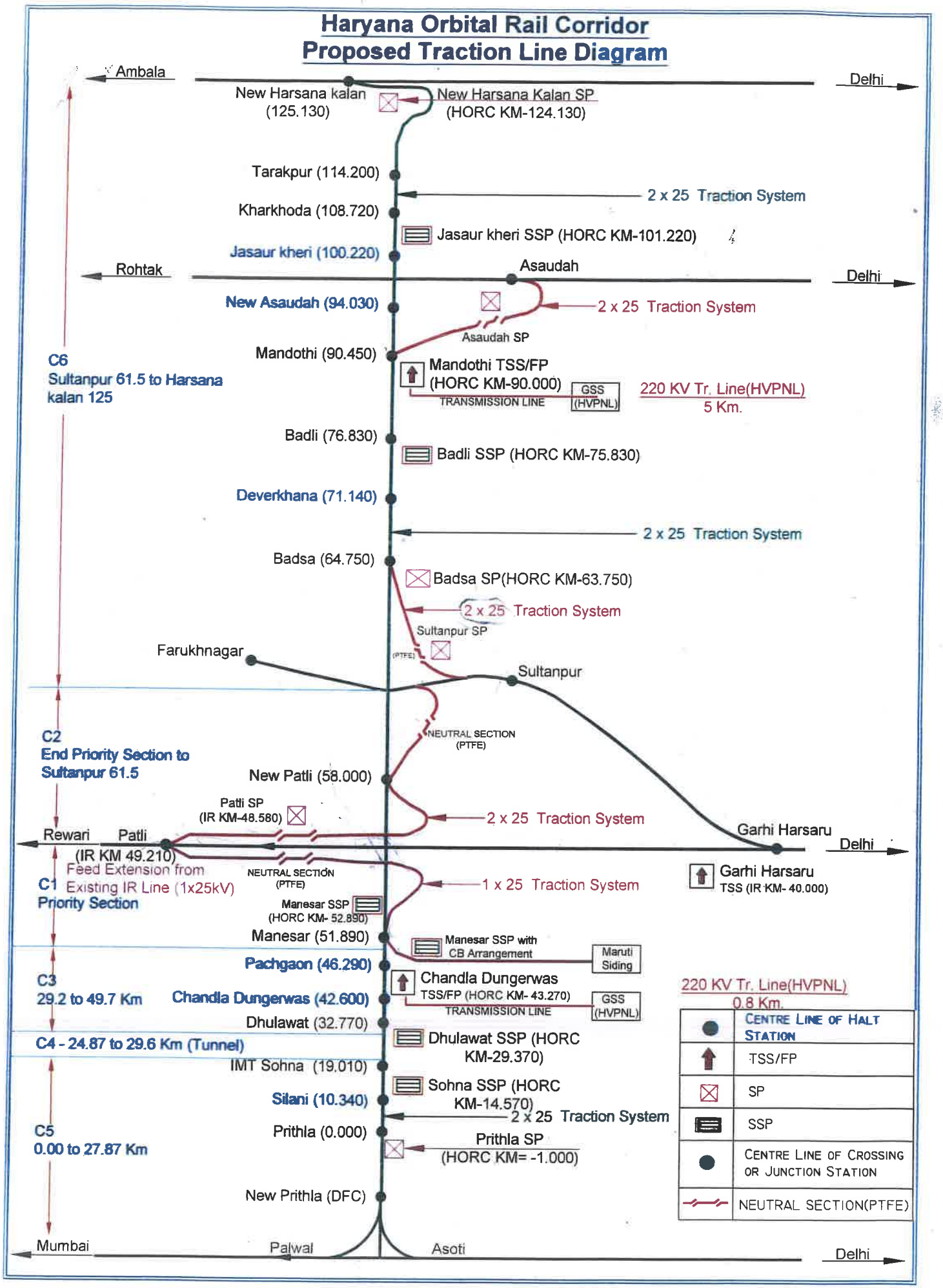
DEVELOPED BY: AMARNATH SINGH CRE/S&T/GC-HORC

GENERAL CONSULTANT FOR HARYANA ORBITAL RAIL CORRIDOR

RITES Limited in consortium with SMEC International Pty. Ltd.

TO SUIT ESP NO. GC-HRIDC-C2-DRW-ALN/ESP-001-A0

RELEASED FOR: PRELIMINARY FOR APPROVAL ☐ TENDER ☑ CONSTRUCTION ☐


Haryana Orbital Rail Corridor
Proposed Traction Line Diagram
Ambala
Delhi
New Harsana kalan (125.130)
New Harsana Kalan SP (HORC KM-124.130)
Tarakpur (114.200)
2 x 25 Traction System
Kharkhoda (108.720)
Jasaur kheri SSP (HORC KM-101.220)
Jasaur kheri (100.220)
Rohtak
Asaudah
Delhi
New Asaudah (94.030)
2 x 25 Traction System
Asaudah SP
Mandothi (90.450)
Mandothi TSS/FP (HORC KM-90.000)
TRANSMISSION LINE
GSS (HVPNL)
220 KV Tr. Line(HVPNL) 5 Km.
C6 Sultanpur 61.5 to Harsana kalan 125
Badli (76.830)
Badli SSP (HORC KM-75.830)
Deverkhana (71.140)
2 x 25 Traction System
Badsa (64.750)
Badsa SP(HORC KM-63.750)
2 x 25 Traction System
Sultanpur SP
(PTFE)
Farukhnagar
Sultanpur
NEUTRAL SECTION (PTFE)
C2 End Priority Section to Sultanpur 61.5
New Patli (58.000)
Patli SP (IR KM-48.580)
2 x 25 Traction System
Rewari
Patli (IR KM 49.210)
Garhi Harsaru
Delhi
Feed Extension from Existing IR Line (1x25kV)
C1 Priority Section
NEUTRAL SECTION (PTFE)
1 x 25 Traction System
Garhi Harsaru TSS (IR KM- 40.000)
Manesar SSP (HORC KM- 52.890)
Manesar (51.890)
Manesar SSP with CB Arrangement
Maruti Siding
Pachgaon (46.290)
Chandla Dungerwas TSS/FP (HORC KM- 43.270)
TRANSMISSION LINE
GSS (HVPNL)
220 KV Tr. Line(HVPNL) 0.8 Km.
C3 29.2 to 49.7 Km
Chandla Dungerwas (42.600)
Dhulawat (32.770)
Dhulawat SSP (HORC KM-29.370)
C4 - 24.87 to 29.6 Km (Tunnel)
IMT Sohna (19.010)
Sohna SSP (HORC KM-14.570)
Silani (10.340)
2 x 25 Traction System
C5 0.00 to 27.87 Km
Prithla (0.000)
Prithla SP (HORC KM= -1.000)
New Prithla (DFC)
Mumbai
Palwal
Asoti
Delhi
CENTRE LINE OF HALT STATION
TSS/FP
SP
SSP
CENTRE LINE OF CROSSING OR JUNCTION STATION
NEUTRAL SECTION(PTFE)

Appendix- 11 (INTERFACE REQUIREMENTS)

1. Interface with Civil package (C-1, C-23) :

S.No.	Description	Remarks
1	Providing access to site for "S&T" Contractor for S&T works.	Civil package Contractors shall complete the following civil works but not limited to: • Provide access to "S&T" Contractor for S&T works. .

2. Interface with Br-1:

S.No	Description	Remarks
1	Providing access to site for "S&T" Contractor for S&T works	• Br-1 Contractor shall complete the works and provide access to "S&T" contractor for S&T works

3. Interface with T-1:

S.No	Description	Remarks
1	Handing/Taking over of site for track related work	T-1 Contractors shall complete the work for laying of Track, Cross Overs, Points and fittings, Derailing switches etc. and handover the site to "S&T" contractor

4. Interface with Traction, Electrification, E&M and associated Works Contractor:

S.No	Description	Remarks
1	LT Power Supply, E&M and Associated works	• Electrical contractor shall complete the required work of provision of LT power Supply, E&M and associated works in S&T Rooms at Station and Station Huts/ TSS/SSP/SP as per contract and handover the site to S&T contractor

(End of Appendix-11)

Section 5: Works' Requirements

5 – III: Particular Specifications (Telecommunication)

Table of Contents

CHAPTER 1 - INTRODUCTION

1.1 GENERAL

1.1.1 Haryana Oribital Rail Corridor (HORC) Railway project will run from exiting DFCCIL Station 'New Prithila' to IR station Harsana Kalan via proposed Sohna, Manesar and Kharkhoda stations on double line in the State of Haryana. Single line connectivity to IR station Patli from Manesar and New Patli shall be provided. Modification at existing IR stations Patli, Asaudah, Sultanpur and Harsana Kalan shall be carried out.

1.1.2 Control and Monitoring of Traction Power in the HORC shall be via a dedicated Supervisory Control and Data Acquisition (SCADA) System. Traction Power System includes Traction Sub-Station (TSS), Sectioning Post (SP) and Sub-sectioning Post (SSP). Details of these TSS, SP and SSP are given in **Appendix-9.**

1.1.3 Single 6 Quad Cable shall be laid alongwith OFC for Block & Emergency communication.

1.1.4 Traffic, Engineering, S&T and all other control circuits are envisaged on OFC short haul network. These shall be managed from IMD/Manesar & Delhi division of NR.

1.1.5 Some key facilities shall be provided and managed from IMD/Manesar.

1.2 SCOPE OF WORK

1.2.1 Broad Scope of Telecommunication Work :

1.2.1.1 Design, Supply, Installation, Testing and Commissioning of the Telecommunication Network and System. The Telecommunication System shall also include but not be limited to:

a. Supply, laying of splicing/ joining of OFC (Short haul network) & Quad cable along the new section from Patli to Manesar Junction (Approx 5.12 RKM) and Patli to New Patli Junction (3.071 RKM) as per Signalling plan (Note:- Access date for Manesar Jn. And New Patli Jn. is attached as Appdendix)

b. Termination of OFC & Quad cable at SP, SSP and Maruti entry.

c. Extending IR Control circuits & TPC to stations, SP/SSP & Maruti entry etc.

d. Providing Emergency sockets at every Km & approach signals

e. Providing required Telecom Power Supply System at SP/SSP etc.

1.2.1.2 Defect liability of the aforesaid Telecommunication system for One year period after commissioning.

1.2.1.3 Commitment from OEM and Contractor for Long term operation and maintenance support of the aforesaid system for a period of five years with mutually agreed terms.

1.2.1.4 Supply of required equipment as per for modification at IR station Patli

1.2.1.5 Shifting of existing Unchartered Telecommunication Utilities at existing station Patli of IR in connection with proposed S&T work.

1.2.2 Scope of Supplies

1.2.2.1 The scope of supply shall include all necessary Hardware, Software, Firmware,

Accessories, Materials and Documentation for Telecommunication System. The detailed requirements is in following chapters.

1.2.2.2 The scope of supply shall also include supply of **Spares, Tools and Test Equipment** as stipulated in following chapters.

1.2.3 Scope of Services

1.2.3.1 The scope of services to be performed by the Contractor shall include :

i) System Design

ii) System Assurance

iii) Installation

iv) Testing and Commissioning

v) Defect liability of the system for one year

vi) Long term AMC

1.2.3.2 Maintenance Support Services including rectification & removal of defects during the Defect Liability Period and Training for Employer's Personnel.

1.2.4 Scope Of Work under Schedule- C:

1.3 RELEVANT DOCUMENTS

1.4.1 This Particular Specification (PS) shall be read in conjunction with the Conditions of Contract, the General Specification (S&T) and any other document forming part of the Contract.

1.3.1 In the event of a conflict between this document and others, the following precedence shall apply:

1. Employer's Requirements-Particular Specification (Telecommunication Works).
2. Employer's Requirements-Particular Specification (Signalling Works).
3. Employer's Requirements-General Specifications (S&T)
4. General and Subsidiary Rules (G & SR) of NR
5. Indian Standards referenced in this document including Indian Railway Telecom Manual.
6. Other National Standards.
7. International Standards referenced in this document.
8. Other International Standards.

1.3.2 Notwithstanding the precedence specified above, the Contractor shall seek clarification from the Engineer in the event of conflict among above specifications and decision of the Engineer shall be final and binding.

(End of Chapter-1)

CHAPTER 2 — CODES AND STANDARDS

2.1 LIST OF CODES AND STANDARDS

RDSO Specification with latest amendment shall be considered for various Telecommunication equipment. A copy of this specification shall be submitted with the specification of the equipment for engineer's approval. A list of specifications has been indicated as following:

Standards/ Specifications	Topic
RDSO/SPN/TC/110/2020	24/48 Fibre Armoured Optical Fibre Cable
RDSO's STT/TAN/IP-MPLS/2020	Technical Advisory Note (TAN) on "Implementation of IP-MPLS Technology for Unified Communication Backbone on Indian Railway"
RDSO/SPN/TC/109/2019	Integrated Communication System for Tunnels
RDSO/SPN/TC/65/2021	IP based Video Surveillance System
IRS:TC:68/2012	Primary digital multiplexing equipment
IRS:TC 30-05	Underground railway jelly filled telecom 0.9mm quad cables for signalling & telecom installations
RDSO/SPN/TC/72/07	1.4mm DIA COPPER CONDUCTOR 4/6 QUAD CABLE
RDSO/SPN/TC/27/2007	"Digital/ISDN & IP ready EPABX system and attendant console – for more than 256 ports equipped for & up to 5000 ports"
RDSO/SPN/TC/69/2007	Patch Cord and PIG TAILS
RDSO/SPN/TC/99/2012	VoIP based train control communication system
RDSO/SPN/TC/102-2013	SMPS based telecom integrated power supply system for station
RDSO/SPN/TC/37/2020	Fibre Distribution Management System (FDMS) & Fiber termination board (FTB).
RDSO/SPN/TC/038-2002	Voice datalogger/ monitor for control circuits
IEC60793 & IEC60874	Optical Fibres and Connectors
RDSO/SPN/TC/107/2018	VHF Sets

RDSO/SPN/TC/73/2008	VHF Based Secured Station Communication Equipment (SSCE)
RDSO/SPN/TC/63/2006	Public address system
RDSO/SPN/TC/108/2019	IP Based Integrated Passenger Information System
ITU-T Recommendation G.811 and G.812	Master Clock synchronisation timing and timing distribution requirements.
ITU-T Rec. G.652	ODF: Optical connectors compliance
RDSO/SPN/TC/84/2008	Router
RDSO/SPN/TC/83/2020	LAN Switch
IEEE 802	Layer-3, Layer-2 switches
RDSO/SPN/TC/45/2013	Permanently Lubricated HDPE Duct
RDSO/SPN/TC/68/2014	Joint Enclosure For Armoured Optical Fibre Cable
IRS: TC 41-97	Polythene insulated polythene sheathed jelly filled telephone cable with poly-al moisture barrier
IRS: TC 77-2012	Thermoshrink jointing kit for jointing underground QUAD cable
RDSO/SPN/TC/57/2015	Thermoshrink jointing kits for jointing underground PIJF cable.
IRS/TC/76-2021	Two/Three V.F. Transformers (2T/3T) For Derivation and Termination of Underground Telecom Cable Circuit
IRS : TC-60/2007	4 Wire/ 2Wire train traffic control equipment with dual tone multi frequency(DTMF) signalling
IRS TC 82 - 2005	Universal way side DTMF control telephone
IRS: TC 61-93	Emergency Control Room Equipment
IRS:TC-42/20	Six pin emergency plug and socket

RDSO/SPN/TC/44/2002	Emergency socket box of FRP material
IRS TC 78/2000	4 wire portable control telephone
RDSO / SPN/TC/97/2012	Telecom cable termination boxes for indoor use (non-metallic)
RDSO/SPN/TC/34/2002	Voice frequency communication system for Underground QUAD Cable
RDSO/SPN/TC/98/2011	Surge protective devices for Telecommunication equipment
IEEE 1100 NFPA 780 IEC 1024	Earthing System Standards
IR S93-96 TEC Spec: GR/BAT-01/03 March 2004	VRLA Battery cells
RDSO/SPN/TL/23/99	Battery chargers
RDSO/SPN/TC/62/2008	Digital Clock with GPS Synchronization
EN 50121 IEC 61000	EMC - Intra & Inter System EMI- Equipment is adequately protected against EMI, EMC-EMC testing
IEC 62278	RAMS
EN-50159	All vital & safety related information shall be implemented as per this standard in both First & Second OFC network
IEC 60065, IEC 60364	System Safety Requirement
IEC 60950	Safety of Information Technology Equipment
IEC 60364	Electrical Installations of Buildings
ITU-T M-3010	Principles for Telecommunication Management Network

TEC/GR/TX/SDH-04/04.JAN.2011.	SDH equipment

(End of Chapter-2)

CHAPTER 3 - PERFORMANCE REQUIREMENTS

3.1 GENERAL

3.1.1 The Contractor shall ensure that all equipment and material used shall meet the specified availability throughout its service life as required to minimise disruption to the train operation and to minimise the maintenance costs.

3.1.2 The System so designed shall have a minimum service life as following:

S.No.	Sub system/Equipment	Service Life (Years)
1.	All the cables including Optical Fibre Cables, Jelly Filled Telecom Quad Cable, Telephone Cables and RF Cables etc.	25
2.	VRLA Cells	7
3.	OFC System (Equipment)	15
4.	Telephone system	15
5.	Other Sub system/ electronic equipment	15

Service life shall be counted from the commencement date of the Defects Notification Period.

3.1.3 The System shall be designed to facilitate Passenger/ freight trains and station operation, management of incidents and abnormal operations as well as of emergencies.

3.1.4 The System shall have no credible failure mode to the extent practicable which will directly cause an interruption or delay in the Train services. The Contractor shall demonstrate that the probability of occurrence of the credible failure mode, if any, has been reduced to ALARP (as low as reasonably practicable) and no further cost-effective means of improving reliability can be identified.

3.1.5 Reliability-Availability-Maintainability-Safety (RAMS) Plan for Telecommunication System shall be developed and implemented in accordance with IEC 62278.

3.1.6 Wherever the equipment being provided under Contract Package "PATLI/S&T" is being upgraded/augmented/reconfigured, the service life of these upgraded/augmented/reconfigured equipment shall meet the residual life of system.

3.2 RELIABILITY REQUIREMENTS

3.2.1 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.

3.2.2 The Contractor shall submit Mean-Time-Between-Failures (MTBF) figure for major equipment of each sub-system as specified in relevant chapters of this Particular Specification. It should be possible to achieve the required level of system availability, as specified in the relevant chapters of this Particular Specification, with these MTBF figures.

3.2.3 The Contractor shall submit Reliability Plan to the Engineer for review in accordance with RAMS Plan.

3.2.4 The Reliability Plan shall describe the analytical methods to be used during design and development to demonstrate compliance with reliability requirements and identification of reliability-critical items in the System offered.

3.2.5 The Reliability Plan shall identify a comprehensive list of reliability-related submissions such as specifications, standards, method statements, procedures, drawings and records to the Engineer for review.

3.3 AVAILABILITY REQUIREMENTS

3.3.1 Detailed availability requirements for individual sub-systems are given in relevant Chapters of this Particular Specification.

3.3.2 The Contractor shall submit calculations with reliability block diagrams for each sub- system to demonstrate the compliance with required availability figures. The availability calculation shall take all possible failure modes into consideration. The calculation shall be based on the Contractor's submitted equipment MTBF figures, MTTR figures and the configuration of each sub-system.

3.3.3 Equipment duplication, hot-standby protection, parallel-run, path diversity, etc. shall be adopted whenever necessary and appropriate to meet the required availability.

3.3.4 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.

3.3.5 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.

3.3.6 The Contractor shall conduct analysis and propose methods, if any, for further improvement of the availability of each sub-system beyond the minimum required availability figures mentioned above.

3.4 MAINTAINABILITY REQUIREMENTS

3.4.1 The Contractor's Response Time is defined as the time that elapses between the reporting of a fault and the maintenance personnel arriving at site where the faulty equipment is located.

3.4.2 The System shall be designed such that the Mean Time to Repair (MTTR) shall not exceed 2 hours. The MTTR shall include the diagnostic time, active repair/replacement time and adjustment/testing time on site, but shall exclude the Contractor's Response Time.

3.4.3 All plug-in modules shall permit hot swapping so as not to affect the normal or emergency operation of the System.

3.4.4 The System shall be suitably designed to minimise the need for frequent preventive maintenance.

3.4.5 The System shall be so designed as to avoid the need for a total shutdown for preventive maintenance.

3.4.6 The System shall be so designed as to prevent failures or breakdown due to invalid or incorrect inputs.

3.4.7 Built-in self-diagnostics, power-up self-test and sufficient test points shall be provided in the System to minimise the time required to locate a fault.

3.4.8 All components, materials, software and supports required for repair and servicing of the System shall be available during the entire lifetime of the System.

3.4.9 The Contractor shall submit Maintainability Plan to the Engineer for review in accordance with RAMS Plan.

3.4.10 The Maintainability Plan shall describe the analytical methods to be used during design and development stages to demonstrate compliance with maintainability requirements specified herein and to identify the maintainability-critical items of the System.

3.4.11 The Maintainability Plan shall identify a comprehensive list of maintainability-related submissions such as specifications, standards, method statements, procedures, drawing and records to the Engineer for review. The Maintainability Plan shall include the date of submission.

3.5 SYSTEM SAFETY REQUIREMENTS

3.5.1 The Contractor shall support other Project Contractors with the provision of information and relevant analysis where the availability and usability of the Telecommunications System is a contributing factor to the overall system risk.

3.5.2 All Man-Machine-Interfaces shall be designed with the risk of Repetitive Strain Injury (RSI), eye strain and radiation-induced illness (both non-ionising and ionising radiation) taken into consideration.

3.5.3 The design of the System shall minimise the risk of fire.

3.5.4 The design of the System shall minimise the build-up of static, as well as the effects of static discharge during maintenance.

3.5.5 Components or materials containing toxic chemicals or asbestos shall not be used in the System unless absolutely necessary and unavoidable. Specific Approval of Engineer shall be obtained before using these components or materials containing toxic chemicals or asbestos.

3.6 ELECTROMAGNETIC COMPATIBILITY

3.6.1 The Contractor shall prepare and submit, EMC Management Plan, for review by the Engineer, which shall be based upon a top-down approach, define the EMC philosophy, activities, means of control for the design processes and EMC submissions to be supplied to demonstrate compliance with the PS and GS. The EMC Management Plan shall also identify a comprehensive list of specifications, standards, method statements and procedures to be submitted to the Engineer for review.

3.6.2 In respect of the EMC Design Documentation, the Contractor shall demonstrate by theoretical analysis that the design, of the electrical and electronic systems under this PS, is fully compliant with the EMC requirements identified.

3.6.3 The Contractor shall provide detailed calculations and inter-modulation analysis to establish electromagnetic compatibility (EMC) among the Sub-systems and with other systems in close proximity as part of EMC Design Documentation.

3.6.4 The Contractor shall ensure that all Intra-system EMC are taken care of through proper design and other measures in accordance with EN 50121 and IEC 61000.

3.6.5 The Contractor shall liaise and co-ordinate with all other Contractors in the exchange of EMC data and related equipment performance characteristics. Inter-system EMC between Telecommunication System and other electrical and electronic equipment shall be in accordance with EN 50121 and IEC 61000.

3.6.6 The Contractor shall ensure that all electrical and electronic apparatus of Telecommunication System is designed and protected against electromagnetic interference in accordance with

EN 50121 and IEC 61000, to operate without degradation of quality, performance or loss of function in the electromagnetic environment of the Project. Adequate safety margins between the immunity levels of the Telecommunication System and the emission levels of other electrical and electronic equipment must be maintained.

3.6.7 The cost incurred in the suppression of electromagnetic or electrostatic interference including any hardware shall be deemed to be included within the Contract.

3.6.8 EMC considerations shall be incorporated in the Contractor's procedures for product safety and design Verification.

3.6.9 EMC Testing shall be carried out on all equipment identified in the design stage which requires attention regarding EMC in accordance with IEC 61000 and to meet overall compliance to EN 50121.

3.6.10 Relevant EMC test certificates for all standard off-the-shelf products shall be submitted to the Engineer for review.

3.6.11 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.

3.6.12 The Contractor must be fully aware of the EMC requirements and any modifications to systems and equipment carried out by the Contractor during the Defects Notification Period shall not cause the immunity, or emission levels of the installed system and equipment to exceed such values.

3.6.13 Any equipment consisting of sensitive electronic components that is likely to be handled or touched by any person shall be protected against electrostatic discharge and shall be tested as defined in IEC 61000-4-2.

(End of Chapter-3)

CHAPTER 4 - DESIGN REQUIREMENTS

4.1 DESIGN APPROACH

4.1.1 The Contractor shall adopt a structured, modular and top-down approach for the design and exercise proper design control to ensure that the designs are in accordance with the requirements given in the Specifications.

4.1.2 The technologies adopted for the design of Telecommunication System shall be:

4.1.2.1 Field proven with past successful applications references

4.1.2.2 Conforming to present IRS/RDSO/TEC/National/International standards

4.1.3 The System design shall be based on redundant hardware in hot-standby configuration to minimise the single point of failure of the System.

4.1.4 The System shall be designed for continuous unattended operation for extended periods of time.

4.1.5 The Contractor shall submit a Design Plan. The design shall be in three stages of Preliminary Design, Detailed Design and Installation Design. The Design Plan shall define Contractor's policy for the design of works and shall without limitation, define;

4.1.5.1 The organization of Contractor's design staff with particular reference to the design interfaces in detail;

4.1.5.2 The specific allocation of responsibility and authority given to identified staff with particular reference to the review and verification of design specification, drawings and calculations by the Contractor in detail.

4.1.5.3 The design and performance requirements which shall be defined in terms of basic data and design assumptions made, relevant codes, standards and regulatory requirements, safety, reliability, security and environmental requirements and commissioning requirements in detail;

4.1.5.4 The process of formal design review, authorization and approval of design documentation; and

4.1.5.5 The process of independent design Verification and Validation.

4.1.6 During the Preliminary Design, the Contractor shall prepare System Requirement Specifications (SRSs) for each Sub-system and shall submit to the Engineer for review, which includes, as a minimum, operational, functional, performance and design requirements. System Requirement Specification shall serve as Contractor's top level design document and shall state all the requirements completely and unambiguously and how each requirement can be verified and validated.

4.1.7 Preliminary Design of individual Sub-systems shall be prepared and submitted to the Engineer for review, which includes, as a minimum, the function of each System, Sub-system, equipment or other element within the overall SRS and specify the relationship and interfaces between each element of the System, including the systems of the interfacing elements of the other Contractors.

4.1.8 The Detailed Design for individual Sub-systems shall be developed based on the Preliminary Design for individual Sub-systems and submitted to the Engineer for review. Detailed Design shall also include electrical and control schematics to illustrate, how the various operational and functional requirements can be achieved.

4.1.9 Software design & development shall also be carried out during Detailed Design stage, and shall be included in the Detailed Design Submission for review of Engineer.

4.1.10 The Detailed Design shall include as necessary all technical aspects of all interfaces with other elements of the Contractor's overall design and of any interfaces with works being supplied by other Contractors. Detailed interconnection specification shall also be developed during this stage and included in the Detailed Design.

4.1.11 The Detailed Design shall also include detailed design calculations, and supporting drawings, documents, etc., for the applicable subsystems The design calculations shall demonstrate that the Contractor's Design fully complies with the requirements given in the specifications and shall further demonstrate that the ratings, capacity and quantity of the proposed equipment are adequate.

4.1.12 The Contractor shall also furnish the following calculations and analysis for each Sub- system as a minimum:

4.1.12.1 Estimation of the power consumption and heat dissipation per equipment location.

4.1.12.2 Prediction of the reliability and availability of the Sub-systems.

4.1.13 Upon approval of Detailed Design, the Contractor shall produce the respective Installation Design, which shall include, inter alia, the Equipment Layout Drawings, System Specifications, Installation Drawings, Cable Route Plan, E1/Channeling plan, Termination Plans, Configuration Details and all other associated documents necessary to supplement the design covered in the Detailed Design and to comply with the Contract regarding the installation of the equipment such as detailed Method Statement, Safety Risk Assessment etc.

4.1.14 As part of Installation Design, specified clearance as per SOD of track side equipment in milli metres from centre line of adjacent track(s) shall be prepared in a tabular form.

4.1.15 Only those drawings and documents of Installation Design that have been endorsed and certified as having been reviewed shall be issued to the Site.

4.1.16 If the Contractor identifies the need for any change to the design due to site conditions or other reason, then the Contractor shall produce a Design Change Notice or Field Change Notice.

4.1.17 The Design Verification and Validation Plan, supplementary to Design Plan shall be prepared by the Contractor in order that design Verification and Validation activities are properly directed.

4.1.18 The Contractor shall by means of the design Verification and Validation process demonstrate that all requirements within the specifications have been met. For this the Contractor shall prepare a Design Verification Table (DVT) that identifies the Contractor's proposed methodology for demonstrating compliance and submit to the Engineer for review. DVT shall include Acceptance Criteria for achieving the requirement. DVT shall be monitored throughout the design and construction of the works. Changes, if any to the DVT, shall be submitted to the Engineer for review before implementation.

4.2 DESIGN REVIEW

4.2.1 The Contractor shall ensure that all design submissions are accurate, fully compliant, relevant and of good quality before they are submitted to the Engineer for review.

4.2.2 The design submission shall include following but not limited to:

4.2.2.1 Preliminary Design

4.2.2.2 Detailed Design

4.2.2.3 Good for construction/ installation drawings or documents

4.2.2.4 As-Built drawings or documents and Operation & Maintenance manuals for whole work

4.2.3 The Contractor shall ensure that all comments of the Engineer have been properly incorporated or otherwise resolved before resubmission.

4.2.4 The Contractor shall exercise adequate control to ensure that the number of resubmissions is a minimum. The following issues shall be addressed during Design Review Meetings:

- Design Progress Interface Issues

4.3 PRELIMINARY DESIGN FOR TELECOMMUNICATION SYSTEM

The Preliminary design and documents for Telecommunication works shall include following but not limited to:

4.3.1 Telecom Architecture drawings as Block diagrams showing information flow from various Telecom subsystem within a station, station to station, TSS/SP/SSP and Control centre to station bringing out clearly the redundancies

4.3.2 Specifications of all equipment for Telecommunication System

4.3.3 Typical Quad cable allocation plan

4.3.4 Typical Equipment Layout, Position of racks/cabinets/enclosurs, Sizing and Layout for Station, S&T Hut, TSS/SP/SSP etc.

4.3.5 Earthing, Lightning & Surge protection plan/ arrangement for Indoor and outdoor Telecom equipment

4.3.6 Typical drawings of Power supply for a Station, S&T Hut, TSS/SP/SSP etc.

4.3.7 Typical drawings for Bridge crossing of Major, minor and other bridges by Telecommunication cables

4.3.8 Typical drawings for Road crossing and Track crossing by Telecommunication cables

4.3.9 Typical drawings for Laying of Telecommunication cable in Station limit and outside of station limit

4.3.10 Typical Cable layout plan for all cables

4.4 DETAILED DESIGN FOR TELECOMMUNICATION SYSTEM

The Detailed design and document for Telecommunication works shall include following but not limited to:

4.4.1 Detailed Wiring diagram for OFC system

4.4.2 Detailed Wiring diagram for Quad Cable Communication System

4.4.3 Detailed Wiring diagram for DTMF Train control communication system and Emergency communication system

4.4.4 Detailed Wiring diagram for Telecom Power Supply System as required

4.4.5 Detailed Earthing arrangement for Indoor at Station, TSS/SP/SSP Station Antenna etc.

4.4.6 Equipment Layout Plans for Telecommunication Equipment Room, S&T Hut, TSS/SP/SSP etc.

4.4.7 Racks, cabinets layout drawings showing the arrangement of individual module;

4.4.8 Cable route diagrams for cables within each equipment room.

4.4.9 Outdoor Cable route drawings for station, mid-section etc.

4.4.10 Detailed Quad allocation chart

4.4.11 Detailed Network diagram for whole project

4.5 GOOD FOR CONSTRUCTION DRAWINGS

The GOOD FOR CONSTRUCTION drawings for Telecommunication works shall include but not limited to:

4.5.1 All drawings and documents described for Preliminary/ Detailed Design & Documents for Telecommunication Works.

4.6 AS-BUILT DRAWINGS

AS-BUILT Drawings & Documents for Telecommunication works shall include but not limited to:

4.6.1 All drawings and documents described for GOOD FOR CONSTRUCTION of Telecommunication Works.

4.6.2 Official letters regarding the design change acceptance;

4.6.3 Certificates of acceptance between the Contractor and the Engineer;

4.6.4 Operation & Maintenance manuals for whole Telecommunication system/ subsystems

4.7 MAN MACHINE INTERFACE DESIGN

4.7.1 For all MMIs specially designed or customised for the System, the Contractor shall provide and shall organise prototypes for demonstration and submission to the Engineer for review prior to implementation.

4.7.2 All MMIs shall be equipped with virus checking and anti-virus protection facilities to prevent from virus infection.

4.7.3 The Contractor shall co-ordinate with the Project Contractors to ensure that the latter's recommendations are properly reviewed, commented upon and the agreed items incorporated in the Contractor's MMI design.

4.8 SUMBISSION OF SAMPLES

4.8.1 The Contractor shall submit samples to the Engineer for review, when so required and instructed by latter.

4.8.2 The Contractor shall arrange site visits and/ or videos for illustration if the items are bulky or impracticable for submission.

4.8.3 The Contractor shall provide samples of individual types of cables to the Engineer prior to the commencement of cable installation. The samples shall be properly protected with transparent housing for independent cable components including sheath, armour, insulation, cable cores, etc. for ease of identification as well as inspection. Each sample shall be properly labelled with description of the cable type.

4.8.4 All samples submitted to the Engineer shall become the property of the Employer.

4.9 EQUIPMENT DESIGN

4.9.1 General Considerations

4.9.1.1 Specific equipment design requirements for individual Subsystems are given in relevant chapters of this Particular Specification.

4.9.1.2 The offered equipment shall be field proven with past history of successful performance in railway environment.

4.9.1.3 All equipment shall be designed and constructed to operate without degradation in quality, performance or loss of function in the electromagnetic environment prevalent in a standard Heavy Passenger/ Freight Corridor Railway System.

4.9.1.4 All Housing, Enclosures and Cabinets housing outdoor equipment shall be compliant to IP65 for Ingress Protection.

4.9.2 Fire and Smoke Precautions

4.9.2.1 The cable routes shall be suitably designed to prevent trapping of rubbish which could later become a fire hazard.

4.9.2.2 Every possible precaution must be taken to prevent the flow of fault currents through the cables, especially from the traction power system. Communication cables must be kept away from high tension power supply cables.

4.9.2.3 All necessary measures shall be adopted to prevent the creation of hazardous conditions arising out of overheating and/or ignition of cables.

4.9.2.4 All the above requirements shall be fully complied without compromising any of the mechanical or electrical properties of the cables.

4.10 ENVIRONMENTAL CONDITIONS

4.10.1 All equipment shall be protected from damage or degradation in performance due to shock or vibration as experienced in railway environment.

4.10.2 Unless otherwise specified all indoor Telecommunication Equipment installations shall be designed for operation continuously in environmental temperatures range of -5°C to +55°C.

4.10.3 Telecommunication Equipment Room (TER) at SCC and Stations shall be provided with Air-Conditioning. Provision of Air-Conditioning in TERs at SCC and at Stations is covered under scope of the Electrical Package. TER at SCC is classified as 'Class-A' and TERs at Stations are classified as 'Class-B2' under Clause 1.4 of General Specifications (S&T).

4.10.4 Telecom Power Supply Equipment Rooms at HORC Stations shall be provided with suitable means to regulate temperature and maintain air-circulation with 1+1 standby, within limits so as to facilitate proper working of Power Supply Equipment and VRLA battery as during summer time the temperature inside the equipment room is likely to reach very high. These provisions of to regulate temperature and to maintain air-circulation shall be provided under Package of Electrical system.

(End of Chapter-4)

CHAPTER 5 – OPTICAL FIBRE COMMUNICATION SYSTEM

5.1 GENERAL

5.1.1 Specification: As described in Chapter-2 of this document OFC system shall comply following specifications with latest amendment but not limited to:

5.1.1.1 RDSO specification for Fibre armoured optical fibre cable, Permanently lubricated HDPE duct, PATCH CORD AND PIG TAILS, Fibre distribution management system, Router, LAN switch, Joint enclosure for armoured optical fibre cable

5.1.2 The OFC System shall be a highly reliable system since it shall be the primary means of communications between Stations, Interfacing HORC Stations, TSSs, SPs, SSPs etc. on which a number of other operationally critical systems will rely upon.

5.1.3 The OFC System shall provide a high degree of availability by operating on independent optical fibre ring.

5.1.4 The OFC System shall be capable to transport all of the user communication requirements. It shall provide sufficient bandwidth to cater for the communication requirements of various systems under this Contract.

5.2 SCOPE OF WORK

The scope of work shall include, but not be limited to, the supply and installation of following:

5.2.1 UPS system/ battery charger and battery for power supply at TSS/SP/SSP/ S&T Hut and Station.

5.2.2 Fibre Distribution Management System and Fibre Termincation Board (FTB) as per RDSO specification described in Chapter-2 of this document with latest amendment at Patli station/TSS/SP/SSP.

5.2.3 24 monomode fibre underground armoured optical fibre cable as per RDSO specification described in Chapter-2 of this document with latest amendment **from Patli to Manesar and Patli to New Patli**

5.2.4 Underground railway jelly filled telecom 0.9mm quad cables for signalling & telecom installations from Patli to Manesar and from Patli to New Patli

5.2.5 Optical fibre connectors and SFP as per IEC and ITU-T specification described in Chapter-2 of this document with latest amendment.

5.2.6 All required power and data cables

5.2.7 OFC Patch cord and pig tails as per RDSO specification described in Chapter-2 of this document with latest amendment.

5.2.8 Terminating and Interconnecting Equipment.

5.2.9 Splice Boxes/ OFC Joint enclosures

5.2.10 Distribution Frames

5.2.11 Equipment Cabinets, Racks and Cubicles at TER.

5.2.12 9U Racks for TSS/SP/SSP/ Station/S&T Hut.

5.2.13 All required software and licenses.

5.2.14 Installation materials.

5.2.15 All required accessories.

5.2.16 Earthing arrangement as per RDSO, IEEE, NFPA and IEC specification described in Chapter-2 of this document with latest amendment

5.3 SYSTEM REQUIREMENTS

5.3.1 At connecting IR station namely Patli necessary Telecom equipment required under the scope of work shall be provided in existing Telecom equipment room. If space is not available in the existing rooms separate Room shall be provided by the Civil contractor. **(End of Chapter-5)**

CHAPTER 6 – TRAIN CONTROL COMMUNICATION SYSTEM

6.1 GENERAL

6.1.1 Specification: As described in Chapter-2 of this document proposed 4 Wire train traffic way station equipment with dual tone multi frequency(DTMF) signalling shall comply with relevant RDSO/IRS/TEC/IEC standards/ specifications with latest amendment as described in Chapter-2 but not limited to:

6.1.1.1 RDSO specification for

(1) 4 Wire train traffic way station equipment with dual tone multi frequency(DTMF) signalling,

(2) Six pin emergency plug and socket,

(3) Emergency socket box of FRP material,

(4) Telecom cable termination boxes for indoor use (non metallic),

(5) Thermoshrink jointing kits for jointing underground PIJF cable

6.1.1.2 IRS specification for

(1) 0.90mm Dia underground railway jelly filled telecom 6 Quad cables

(2) Emergency Control Room Equipment,

(3) Thermoshrink jointing kits for jointing underground QUAD cable,

(4) Polythene insulated polythene sheathed jelly filled telephone cable with ply-al moisture barrier,

(5) Two/ Three V.F. Transformers (2T/3T) for Derivation and Termination of underground Telecom Cable Circuit

(6) DTMF Control telephone

DTMF control communication system is to provide mainly voice communication between controllers (of various control circuits) at Northern Railway Section control centre (SCC), New Delhi and officials manning such control circuits at way stations /other identified locations as Patli Station, TSS, SP, SSP etc. including Assistant Station Masters (ASM). Emergency Communication System shall provide an omnibus communication channel between SCC and all TSS, SSP, SP, at every Km. in the Mid-section in block section and other locations as per Railway practice between Patli and Manesar and Pali and New Patli. Emergency communication shall be provided along the track through emergency communication sockets at less than one kilometer and as close to KM post and reception signal as possible.

6.1.2 Whenever existing equipment are upgraded/ augmented to meet the requirement of this Particular Specifications, the available provision for Redundancy in existing equipment shall not be compromised and subsequent to upgradation/augmentation they shall meet the Technical Requirement and Performance Requirement as stipulated in this Particular Specifications.

6.2 SCOPE OF WORK:

The Scope of Supply, installation, Testing & commissioning for the TCCS System shall include, but not be limited to the following:

6.2.1 As required Way Side 4 Wire DTMF Control telephones for **station masters** and other users for

6.2.1.1 Train/Section control circuit

6.2.1.2 Traction power control circuit

6.2.2 As required Way Side 4 Wire DTMF Traction Power Control telephones for TSS/SP/SSP and other users of

6.2.2.1 Traction power control circuit

6.2.3 Power Supply Equipment

6.2.4 Cables and Accessories

6.2.5 Distribution Frames

6.2.6 Cabinets, Enclosures, Racks, etc.

6.2.7 Emergency communication socket at every kilometers between Manesar & Patli and New Patli & Patli on existing emergency control circuits.

6.2.8 10 no. lightweight portable emergency control phones

6.2.9 Train Control telephone sets

6.2.10 Traction power control telephone sets

6.2.11 Exchange telephone sets

6.3 FUNCTIONAL SPECIFICATION

6.3.1 Section traffic controller communicates with a group of way stations in his jurisdiction. For other control circuits similar arrangement exists.

6.3.2 Emergency control circuit is omnibus circuit working on the underground cable laid in most of the sections. The length of this cable can go up to 20 km or more between two adjacent way stations. The emergency control circuit is generally a 4-Wire circuit. In normal case, conversations on this circuit are received by Traction power controller/ Power controller. However, in case of need, Traction Power controller/ Power controller shall be able to transfer the conversations on section control circuit.

6.3.3 The underground Quad cable is tapped at intervals of about 1 Km, at TSS/SP/SSP, reception signals and terminated on 6-pin socket. The control office (for a given section) can be contacted by plugging a portable control telephone into any of these sockets provided in that section. 4 wire portable control telephone shall be provided as per IRS specification described in Chapter-2 of this document with latest amendment.

6.3.4 Emergency Control Circuit: An arrangement (gateway) shall be required for interfacing IP network and the emergency control circuit. It shall be possible to reach the control office by plugging a 4 wire portable control telephone into any of the Emergency sockets. The gateways can be provided either at every way station or at HQ. A two-way communication shall be setup between the emergency controller and the site. If any other person plugs his telephone in some other socket on the same emergency control section, he will also join the conference.

6.3.5 It shall be possible to join emergency conference call received on emergency control circuit, to the Section Controller's conference if needed, in control office by Traction Power Controller/ Power Controller who normally also works as emergency controller.

6.4 TECHNICAL SPECIFICATION

6.4.1 Total 10 no. lightweight portable emergency control phones shall be provided for Train and O&M staffs.

6.4.2 Tentative requirements of Telecommunication equipment are as under

6.4.2.1 Mux- 4No.

6.4.2.2 STM-1- 4No.

(End of Chapter-6)

CHAPTER 7- VoIP BASED EPABX SYSTEM AND ATTENDANT CONSOLE

DELETED

(End of Chapter- 7)

CHAPTER 8 – DIGITAL CLOCK WITH GPS SYNCHRONIZATION THROUGH MASTER CLOCK

DELETED

(End of Chapter-8)

CHAPTER 9 - VHF COMMUNICATION SYSTEM

DELETED

(End of Chapter-9)

CHAPTER 10 - POWER SUPPLY SYSTEM

10.1 GENERAL

10.1.1 12V DC Power Supply System for Control phones shall be provided. It shall include Battery Chargers, Battery Banks and Load Distribution Arrangement. The Battery Banks shall consist of Valve Regulated Lead Acid Maintenance Free Cells. The Battery Backup System shall have more than 4 hours backup for 12V DC Power supply system.

10.1.2 Tentative requirements of 12V Power supply system are as given in Table below:

S.No.	Station/Location	Rooms	Tower wagon shed	Nearby Service Buildings/TSS/SP/SSP
1.	Patli IR	1		2
2.	Manesar	1		2
3.	New Patli	1		2
	Total	**3**		**6**

The requirement of 12V Power supply system at individual location may vary. Exact requirement will be identified during Design Stage.

10.2 UPS or 48V DC/ 6A power supply with battery shall be provided for OFC/ Mux equipment at SP/SSP and 3 other locations as per design.

(End of Chapter-10)

CHAPTER 11 – IP BASED PUBLIC ADDRESS SYSTEM

DELETED

(End of Chapter-11)

CHAPTER 12 – IP BASED INTEGRATED PASSENGER INFORMATION SYSTEM

DELETED

(End of Chapter-12)

CHAPTER 13 – INTEGRATED TUNNEL COMMUNICATION SYSTEM

DELETED

(End of Chapter-13)

CHAPTER 14 – QUAD, PIJF AND OTHER TELEPHONE CABLES

14.1 GENERAL

Telecommunication cables shall be laid with compliance of Appendix-2 (Guidelines for Cable laying). Telecommunication lines are usually laid underground between, station yards and in the block sections alongside the track.

14.2 SPARE CAPACITY

All telecom lines shall, as far as possible, be laid in a manner that due provisions are kept for any future extensions or extra connection which can be catered for without considerable alteration to the existing circuits or reconstruction of the entire alignment.

14.3 TYPE OF CABLES

The following types of underground cables but not limited to shall be used for various telecommunication circuits:

14.3.1 Quad Cable 0.9/1.4mm conductor dia as per IRS and RDSO specifications described in Chapter-2 of this document with latest amendment. These are 6 quad polythene insulated jelly filled cable suitable for underground laying and are used for control circuits and block interfaces. It is desirable to provide 1.4 mm Quad cable in block sections longer than 12 kms .

14.3.2 Multi pair (10 pairs to 200 pair), Multi Dia (0.5mm/0.63mm/0.9mm) PIJF (Polythene insulated Jelly Filled) Cable as per IRS specification described in Chapter-2 of this document with latest amendment is suitable for underground laying and is generally used for Exchange subscriber lines or branch cables branching off from the main Quad cable.

14.3.3 Twisted Pair Switch Board Cable of sizes 0.5 mm/ 0.6 mm copper conductor dia as per RDSO/IRS/TEC/IEC specification are not designed for underground laying and are generally used for indoor applications such as distribution to various telephone subscribers in a building, MDF to Exchange wiring etc.

14.4 OUTDOOR UNDERGROUND CABLE

14.4.1 Following outdoor underground cables but not limited to shall be used:

Sizes of conductor	Circuit for use
0.5 mm conductor Dia twisted Pair PIJF or 1.83 kg/km (6.5 lb/mile)	Subscriber's connection up to 5 kms.
0.63 mm conductor Dia. twisted Pair PIJF or 2.81 kg/km (10 lb/mile)	Subscriber's connections up to 10 km.

14.4.2 The size of the telephone exchange cables, shall be specified in a manner indicating the number of pairs, dia. of conductor, type of insulation/ sheath, jelly filled, armoured or unarmoured as illustrated below:

14.4.2.1 50 pair, 0.63 mm conductor dia armoured polythene insulated polythene sheathed jelly filled (PIJF) armoured telephone cable as per IRS specification described in Chapter-2 of this document with latest amendment.

14.4.2.2 In underground laying, minimum 10 pair PIJF armoured cables shall be used.

14.5 INDOOR CABLE

14.5.1 Following indoor cables but not limited to shall be used:

Sizes of conductor	Circuit for use
0.5 mm Annealed Tinned Copper (ATC) Switch Board cable1.76 kg/km	subscriber's connection in a building, exchange to MDF wiring etc.
0.6 mm ATC Switch Board cable 2.52 kg/km	Trunk connections etc.

14.6 TESTING OF CABLE BEFORE LAYING

14.6.1 Before the cable is laid, it shall be tested for insulation and continuity of the cores. Continuity of armour and screen of the cable need to be checked before laying.

14.6.2 Bedding and armouring of the cable shall also be inspected to see that there has been no damage during transit or in storage.

14.7 LAYING OUT THE CABLE

14.7.1 For laying out cables, the cable drums shall be mounted on cable-wheels

14.7.2 The drum on the wheel shall be brought to one end of the trench and the end of the cable is freed and is put into the trench.

14.7.3 The cable-wheels shall then be drawn along the road or track.

14.7.4 A party of labours shall follow the drum and guide the cable from the road into the trench carefully so that the cable will not be damaged or will not be bent unduly.

14.7.5 In case where the wheels are not available, the drum shall be mounted on an axle at one end of the trench and cable shall be laid out and carried by labourers.

14.7.6 In no case, the drum shall be rolled off on to the road for laying the cable and the cable shall be dragged on the ground for laying purposes.

14.7.7 While excavating earth for trenches or making other pits necessary for installation of cab le junction boxes in between the tracks or in close vicinity of the track the Permanent Way Inspector or his representative shall be present.

14.7.8 In 'Quad' type of cables, conductors diagonally opposite shall form one circuit.

14.7.9 In Telephone cables, electro-static and electro-magnetic induction between different pairs of conductors shall be minimised by a lead or aluminium sheath and by the provision of twisted pairs.

14.7.10 Whenever a road-crossing or rail-crossing is encountered in busy areas, HDD (Horizontal Directional Drilling) method should be used to lay all types of cables in DWC pipes or any other approved protection arrangement.

14.7.11 Where concrete large size duct is provided in the station section for laying Signalling cables, the same may be utilized for Telecommunication cables with following of due precautions.

14.8 CABLE TERMINATION

14.8.1 Cables can be terminated in any of the following methods:

- DP Box of approved type

14.8.2 PIJF Telephone cable of various sizes shall be terminated through DP Box of approved type.

14.9 JOINTING OF PIJF TELEPHONE/ QUAD CABLE:

14.9.1 Jointing should be done by a skilled and experienced person using the correct RDSO specified jointing kit to ensure quality.

14.9.2 The entire cable laying and jointing to be done under close supervision of Telecom staff.

14.9.3 Thermoshrinkable jointing material shall be used for jointing armoured PIJF cable with Thermoshrinkable jointing technique using RDSO's code of practice described in the Chapter-2 of this document with latest amendment.

14.9.4 The jointing material is readily available in the form of a jointing kit. For different sizes of cable (Number of pairs and conductor dia.) the kits are different e.g., TSF-1, TSF-2 etc. as per latest RDSO specification. For Quad cable, only Reinforced Thermoshrink Jelly Filled kit (RTSF) type jointing kit to be used as per latest RDSO specification described in Chapter-2 of this document.

14.9.5 Quad cable joints may normally be kept underground or it may be housed inside a location box of proper size avoiding sharp bends. Wherever joint is kept inside the Location Box, EC Socket also should be fixed on that location box itself and that location box should be painted with Black & Yellow strips.

14.9.6 The screen and armour of copper cables shall be jointed suitable wires. This is essential to get the specified screening factor in association with its earthing at stations. This should be done first to avoid any electric shock due to induction.

14.9.7 The Copper cable screen and armour shall be earthed with a low value earth (<10) at stations to achieve the specified screening factor.

14.10 PLANNING FOR CABLE LAYING

14.10.1 While planning for cable laying on a route, the number of conductors and sizes and type of cable (Quad/PIJF) required should be first determined depending upon the type of circuits desired.

14.10.2 It will be generally desirable to leave 25% or more conductors spare for all cables carrying 5 or more pairs of conductors for future expansions as codal life of these cables.

14.10.3 Then actual route for taking the cables should be decided by travelling/walking along the track and deciding upon the best alignment for the cable route.

14.10.4 The desired route should be shown clearly on a route plan showing the actual alignment of Track giving Offsets from Permanent Way or Permanent structures. The diagram should indicate the various roads and Track crossings, Crossings with Power cables, water and sewage mains and other points of importance.

14.10.5 After the route has been decided upon, the convenient points for distribution (Main cable to Smaller distribution cables in case of subscriber cabling for exchange, Emergency socket locations in case of Emergency Communication etc.) should be decided.

14.10.6 The Telecommunication cables should normally be laid within 1 metre inside the HORC boundary. For this the reference should be taken from boundary pillars. Where such pillars do not exist, the concerned P.Way/ works officials to be advised to provide the same. Further it should be laid at least 2 m away from the nearest track and beyond embankment. Trenches in/ nearer to the formation area of track shall be made only after consultation with P.Way staff and it shall be filled up and rammed properly after laying the cables on the same day before sunset. Special care, in this regard, shall be ensured during the monsoon season and in alluvial soil. It shall also be ensured that it is separated by at least 1 m from the nearest electrical power cable.

14.10.7 Concrete Cable markers shall be provided all along the route at a nominal interval of **50m alternatively in Bock Section**. **Additional markers shall be provided to indicate important points like Cable Joints, Water and Sewage Mains, Power Cable, Crossings, Alignment Bends/Curves etc.** The Concrete cable route marker shall be provided in **station section at an interval of 50 m**. The cable shall be at least 1.2 m below the surface of the ground. The trench shall be minimum 0.3m/ sufficiently wide to ensure smooth cleaning of trenches and laying of cables.

14.10.8 In exceptional cases, such as in yards and when the depth of the cable trench is limited to 0.5m due to local conditions a minimum distance of one metre shall be maintained between the cable and the OHE mast supporting the catenary or any other structure likely to come in contact with the high-tension conductors. When the observance of this rule creates difficulty, the cable shall be laid in RCC pipes and in that case the distance to be maintained as specified above can be brought down to 0.5m.

14.10.9 When the depth of the cable trench exceeds 0.5 m. near the OHE masts, it shall be ensured that the nearest edge of the cable trench is at least 3m away from the OHE mast.

14.10.10 Position of cable joints shall be marked on the nearest OHE mast by painting of an approved legend.

14.10.11 Laying of cables in the vicinity of Traction sub-stations, OHE switching stations and their associated earthing system shall be governed by the following principles:

14.10.11.1 In the vicinity of Traction sub-stations, the cable shall be laid at least one metre away from any metallic body of the sub-stations, which is fixed in the ground, and at least one metre away from the sub-station earthing. The cables shall, further, be laid in concrete pipes or enclosed brick channels for a length of 300 m. on either side of the sub-station. As far as possible, the cable should be laid on the side of the track opposite the sub-station side.

14.10.11.2 In the vicinity of the OHE switching stations (feeding posts, sectioning and sub-stationing posts), the cable shall be laid at least one metre away from any metallic body of the station which is fixed in the ground and at least 5 metre away from station earthing. The distance of 5m from station earthing can be reduced to 1m, provided the cables are laid in concrete piles.

14.10.11.3 Where an independent earth is provided for an OHE structure, the cables shall be laid at least 1m away from such earthing.

14.10.12 Outside station limits, the cable shall generally be laid at a standard distance of 10m from the centre of the nearest track.

14.10.13 When Signalling and Telecommunication cables are laid in the same trench, a separation distance of about **100 mm.** is to be maintained between them by placing bricks between them.

14.10.14 HT & LT Power cables and Telecommunication cables shall not be laid in the same trench.

14.10.15 The cable laid parallel to the track shall normally be buried at the depth of **1.0m in station area.** While those laid across the track must be **1m below the rail flanges.**

14.10.16 The trench for the Telecommunication cable shall be kept as far away as possible from the trench for the power cables.

14.10.17 When cables are to be laid along the girder bridges, over the culverts, through the bed of culverts, over the rocky terrain and the like, they shall be laid as per the approved methods for each such location.

14.10.18 While laying, the cables shall not be subjected to sharp bends. The bending radius for the cable shall in **no case be less than 40 times the diameter** of the cable in case of aluminium sheathed armoured cables.

14.11 METHODS OF CABLE LAYING

14.11.1 Cables should invariably be unwound from the cable drum by mounting the cable drum on jack with the axle parallel to the base. It should never be unwound by keeping the drum on its sides.

14.11.2 Cables shall be laid using one of the following methods, viz., laying direct in the trench, drawing through ducts and laying solid. The choice of the method depends upon the type of the cable to be laid, the nature of the cable route, initial outlay and future expansions, and economy in maintenance charges

14.11.3 Direct in the trench method-For direct laying, the bottom surface of the trench is made free of corrosive elements and the cable is laid on the bedding of the soft earth of the trench. Where the bottom surface is rough, a 100mm layer of fine sieved Earth/ Sand shall be used as bedding.

14.11.4 Drawing the Cable through RCC ducts / Pipes: RCC ducts/ GI Pipes or DWC/HDPE pipes may be used for laying the cable. Whenever the cable is laid in the duct, there shall be sufficient holes at the bottom of the duct for draining away of any water that may collect.

14.11.5 Laying solid: For laying solid, a trough is made in an excavated trench and the cable is laid in the trough:

- Molten bituminous compound or asphalt or similar materials of approved type is poured in to fill the trough completely.
- It is then lined with bricks on the top after the compound is set.
- Care is taken to hold the cable in the trough on wooden pieces, so that the cable is entirely surrounded by the molten material.
- This type of laying can be justified only in cases where the soil is chemically detrimental due to electrolytic corrosion, or at critical bridges and theft prone areas.

14.12 TESTING

14.12.1 During cable laying work Cables section shall be tested after each joint is made to facilitate tracing of a fault during the course of jointing.

14.12.2 On discovery of a fault during the cable laying, the last joint must be opened out and defect rectified.

14.12.3 The wires in the cable must be tested just before laying and after laying and jointing and also regularly on the laid cable for the following:

- Continuity
- Absence of crossed pair/quad
- Absence of conductor cores contacts
- Insulation resistance
- Absence of contacts between wires forming a pair (short circuit)
- Transmission loss & cross-talk

- Continuity of armour and screen of the cable need to be checked before laying

14.13 PROCEDURE FOR PREPARATION OF CABLE

14.13.1 To facilitate testing, every wire at the starting end shall be twisted with its mate to form a loop in each pair, each twist being insulated from other pairs by means of PVC sleeves.

14.13.2 The tests shall be conducted from the other end of the cable.

14.13.3 In case of multi-layer cable, the layers of the cable shall be separated with cotton thread or twine to keep the wires in their proper places, so that the position of faulty wire or pair may be easily ascertained.

14.13.4 After the test is over, the end shall be cut and sealed or terminated as per the requirements at site.

14.13.5 In case it is desired to maintain the end for further tests, it may be suitably protected.

14.14 TESTING FOR CONTINUITY, ABSENCE OF CROSSED PAIR AND ABSENCE OF CONTACTS

The following procedure may be adopted:

14.14.1 At one end the cable should be made ready to facilitate testing from the other end.

14.14.2 At the testing end, a Multimeter shall be used for the tests.

14.14.3 All conductors are to be bunched together and then earthed through the armour and screen of the cable with a soft bare copper wire and connected to one probe of the Multimeter. Multimeter to be kept in Continuity Test mode.

14.14.4 Now any of the wire from the bunch may be separated and when touched to the other probe of the Multimeter, it should give continuity buzzer sound and loop resistance value. If the loop resistance value is substantially less than the calculated value as per the loop length, it indicates shorting within the pair.

14.14.5 Disconnect the mate of the wire under test from the bunch and this buzzer sound should disappear proving the absence of crosses and wrong contacts.

14.14.6 If any of the wire shows the cross or contact, they should be earthed again to trace wires with which they are crossed or are in contact. Each pair of conductors should be tested in the above manner before jointing the next length.

14.14.7 Where the test proves that wires have been cross jointed, the joints shall be opened and the fault rectified to avoid crosstalk. Re-crossing in the next jointing does not clear the fault.

14.15 TESTING OF INSULATION

14.15.1 The insulation test shall be taken on half of the pairs of the cable bunched together, the other half being earthed to the armour and screen. The second half shall then be tested in a similar manner with the first half earthed.

14.15.2 The test shall be carried out with a megger before connecting it to the terminal equipment.

14.15.3 If a contact between the wires forming a pair exists, it will be shown by the megger registering a dead earth. In this case, each pair shall be tested individually until the faulty pair is found.

14.15.4 Insulation test of newly laid U/G cable shall be done with a megger of 5OOV and afterwards it shall be done with a megger of 100V/500V depending upon the overall condition of cable and spares available.

14.16 ROUTINE TEST SCHEDULE

Underground cables shall be tested once every year for continuity, transmission loss, cross-talk, loop resistance, armour continuity, insulation resistance and tracing & updation of cable route diagram and the results of tests shall be recorded.

14.17 MAINTENANCE

14.17.1 Underground cable installations when laid strictly in accordance with the recommended practice then it will hardly need any maintenance throughout their anticipated span of life. As far as the buried portion of the cable is concerned, no repairs are generally possible except in cases where moisture or water has entered the cable and is detected before it has damaged the insulation.

14.17.2 No digging operations by other departments shall be carried out close to the cable route without prior notice to the Telecommunication Engineer who shall supervise or arrange supervision to ensure necessary precautions to protect the cable from damage has been taken or being taken during the work.

14.17.3 Each Emergency socket provided through Quad cable shall be inspected once in 15 days for its performance and good shape and the Emergency socket markings on OHE masts shall be well painted.

14.17.4 Quad and PIJF cables in each section should be maintained by a cable gang. The staff strength should be as per the latest yardstick issued by Railway Board. The maintenance gang should have provision for a vehicle where the men and material can be loaded and comfortably reach the site.

14.18 CABLE FAULTS

14.18.1 TYPE:

- Low insulation in one limb or both.
- Open/break in one limb or both.
- Short/Earth.
- Multiple faults.
- Foreign potential

14.18.2 Localisation of faults- Various types of cable fault locators available generally work on the following principle:

- Potential distribution method
- Pulse reflection (ECHO) method

14.18.3 Rectification of faults- After localisation of faults, the defective portion of cable may be replaced by healthy piece of cable with proper joint.

14.19 Voice frequency communication system for Underground QUAD Cable shall be as per Specification described in Chapter-2 with latest versions and amendments.

(End of Chapter-14)

CHAPTER 15- INSTALLATION, EARTHING PROTECTION

15.1 INSTALLATION WORKS IN TELECOM EQUIPMENT ROOMS

15.1.1 All floor-mounted equipment cabinets at the equipment rooms shall be securely bolted to floor/ground, properly aligned and levelled.

15.1.2 All wall-mounted equipment shall be installed at appropriate height to avoid any hazards to the person passing by. The Contractor shall ensure that the wall of additional space if required at interfacing IR stations is of sufficient strength to hold the wall-mounted equipment in a secure and safe manner.

15.1.3 The floor mounted equipment cabinets shall be arranged in the way to allow sufficient space at the front and rear side of the cabinets for maintenance access. Sufficient space shall also be allowed for front maintenance access of the wall mounted equipment.

15.1.4 The equipment layout within the equipment room shall be designed to allow sufficient clearance for escape out of the equipment rooms in case of emergency.

15.1.5 All cable and wires inside the cabinets shall be housed in appropriate cable conduits or tied neatly along the side of cabinets. They shall not cause any obstruction to the access of equipment within.

15.1.6 All optical cable fibres which run outside shall be contained in protective conduits.

15.1.7 Portable Fire Extinguishers shall be provided in Telecom Equipment Room and Telecom Power Supply Equipment Rooms. Portable fire extinguishers shall be compliant to NFPA 10 standard and suitable for electrical equipment.

15.1.8 The Contractor shall submit the Preliminary design, Detailed design, and GFC drawings as described in Chapter-4 of this document to the Engineer for review at least one months before the commencement of the indoor and outdoor installation.

15.1.9 Installation works inside the equipment rooms shall be carried only after these submissions have been reviewed without objection by the Engineer.

15.2 INSTALLATION WORKS WITHIN BUILDINGS

15.2.1 The Contractor shall provide all necessary mounting brackets and accessories for installation of all indoor Telecommunication Equipment as covered in this Particular Specification.

15.2.2 All the mounting brackets and accessories shall be corrosion resistant, aesthetically designed to match with all architectural finishes and of sufficient strength to mount the equipment securely.

15.2.3 All the cable trays/trunks/conduits for cable laying between equipment rooms and indoor Telecommunication equipment shall be provided by the Contractor. The size of trays/trunks/conduits shall be so selected to ensure that cables shall not occupy cross- sectional space in excess of 50%.

15.2.4 After conduits have been laid, they shall be thoroughly cleaned by a mandrel of diameter slightly less than the conduits being drawn through. Subsequently a draw wire of galvanized steel shall be left in each conduit to facilitate the drawing of cables. The conduits ends shall be sealed temporarily to prevent the entry of foreign matter.

15.2.5 The Contractor shall submit the following to the Engineer for review at least three months before the commencement of the installation activities:

- specifications, sample of all the mounting brackets and accessories;

- equipment mounting and installation methods;
- cable trays/trunks/conduits route plan within building showing cross-sectional occupancy; and

15.2.6 Installation works within the building shall be carried only after these submissions have been reviewed without objection by the Engineer.

15.3 OUTDOOR INSTALLATION WORKS

15.3.1 The Contractor shall provide all necessary mounting brackets and accessories for installation of all outdoor Telecommunication equipment as covered in this Particular Specification.

15.3.2 All the mounting brackets and accessories shall be corrosion resistant, aesthetically designed to match with all architectural finishes and of sufficient strength to mount the equipment securely.

15.3.3 All the cable ducts/troughs/trenches or cable trays/trunks/conduits for cable laying between equipment rooms and outdoor Telecommunication equipment shall be provided by the Contractor.

15.3.4 The Contractor shall submit the following to the Engineer for review at least three months before the commencement of the installation activities:

- specifications, sample of all the mounting brackets and accessories;
- equipment mounting and installation methods; and
- schematic diagrams and wiring diagrams of the System.

15.3.5 If the equipment is installed at location exposing to direct sunlight, the equipment, mounting brackets, cables and accessories shall be made of materials which are resistant to ultra violet rays.

15.3.6 All trackside equipment and the mounting method shall be designed in the way to minimise the frequency of preventive maintenance.

15.4 CABLING

15.4.1 All Outdoor Cables (Optical Fibre Cable inside HDPE Duct, Jelly Filled Telecom Quad Cable & PIJF Telephone Cables etc.) shall be laid within IR/HORC boundary and as far away from the track as possible. If it is necessary to lay cable outside the IR/HORC boundary, permission shall be obtained in advance from the concerned authority or cable can be laid on berm with interfacing with civil contractor and proper compaction after backfilling. It shall also be ensured that Jelly Filled Telecom Quad Cable and PIJF Telephone Cables shall not be laid between HORC Track and Indian Railway Track to the extent possible.

15.4.2 The detailed guidelines for Signalling cable laying have been laid down in Appendix-2 (Guidelines for Cable laying). These are applicable for Telecommunication cable laying also.

15.4.3 The Contractor shall prepare a Cable Route Plan in consultation with Civil structure Contractor and get it approved from the Engineer before starting the trenching work. Instructions of Railway Board given in Appendix- 3 (Procedure for digging work near S&T Cables) of PS/Signalling in this connection shall be followed.

15.4.4 All Ducts/Troughs/Trenches for outdoor cable laying shall be provided by the Contractor.

15.4.5 Outdoor Cables shall be laid in a trench with depth of 1.2 metre from the natural earth profile or from the rail level whichever is lower and width of 0.3 metre and suitably protected with bricks.

15.4.6 Electrical Cables (Low Tension & High Tension) shall not be laid in same trench along with Outdoor Telecommunication Cables. Minimum separation between Electrical Cables and Outdoor Telecommunication Cables shall be maintained as specified in Indian Railway Telecommunication Manual.

15.4.7 Outdoor Signalling Cables and Outdoor Telecommunication Cables shall not be laid in same trench. If it is inescapable to lay Signalling Cables and Outdoor Telecommunication Cables in same trench, suitable separation shall be provided between the two as per the requirement of PS-Signalling Works, IRSEM and Indian Railway Telecommunication Manual and approved by the Engineer.

15.4.8 Cable laid in the **slope of track formation shall be laid in Double Wall Corrugated Pipes**. It shall be so laid to maintain a continuous depth of 1 meter (To top of DWC Pipe) from the nearest ground level. The slope of track formation shall be restored to its original condition after laying of cables.

15.4.9 On PCC/RCC bridges DWC pipe shall be provided on top level of the bridges to protect the cables.

15.4.10 On steel girder bridges GI pipe (Class-B/ Blue colour mark) shall be provided on top level of the bridges to protect the cables.

15.4.11 Optical Fibre Cable shall be laid in Lubricated HDPE pipes.. Cables shall be laid in DWC pipe through trenchless method while crossing the road or the railway line DWC pipe shall have a minimum 6 mm wall thickness.

15.4.12 Before commencing work on any part of the Site, the Contractor shall ascertain that the Engineer and also, where applicable, the local and statutory authorities or other bodies/persons concerned have reviewed each cable route without objection. The Contractor shall further ensure that all necessary permits in such cases have been obtained and notices served.

15.4.13 The Contractor shall provide his own brackets and clips to secure all the cables at an adequate interval. Where cables are to be laid in troughs, the Contractor shall remove and re-instate trough covers prior to and after cable installation.

15.4.14 A labelling scheme shall be applied for all cables installed. Each cable shall be uniquely identified. Labels shall be tied at both ends, at entry and exit points of cable trays, ducts and trenches and at appropriate locations where necessary. Type of labels to be used shall be got approved by the Engineer.

15.4.15 Cable drums shall always be mounted on jack and rotated for uncoiling and paying out of cable. Cable shall not be pulled for this purpose.

15.4.16 Cable drum shall never be kept on its side and cable uncoiled. Since this can result in twisting of cable conductors resulting in damage to them, any such instance noticed shall result in the following liabilities on the Contractor:

- Remove such laid cable and cut into pieces of scrap of about 2 metres each;
- Lay new cable in lieu;

15.4.17 The installation and handling of cables shall be undertaken at all times by adequate staff suitably trained and supplied with all necessary plant, equipment and tools. The arrangement

of the cables and all methods of laying shall be planned to provide an orderly formation, free from unnecessary bends and crossings.

15.4.18 Cables in any trough/duct or tray/trunk/conduits shall not occupy cross-sectional space in excess of 50%.

15.4.19 At no location the cable shall be bent with a radius lower than the minimum radius recommended by the manufacturers. Sharp edges shall be avoided.

15.4.20 Every precaution shall be taken to ensure that cables and equipment are not installed in a manner or under conditions likely to cause electrolytic or other corrosive action or damage to, or be detrimental to, the performance of the cables and equipment during operation.

15.4.21 Tail cables shall be mechanically protected to avoid being damaged from track side maintenance activities and shall be immune to any malfunction from electromagnetic interference.

15.4.22 All cables shall be adequately rated for their duties. All power cables shall be able to withstand full load current for peak operation when the equipment is at its ultimate capacity.

15.4.23 Unused cable cores/pairs of multi-core/pair cables shall also be terminated and marked so

15.4.24 The Contractor shall ensure that the maximum length of parallelism is suitable to the requirement of 25 KV AC traction Feeding of 25 KV AC Traction and that of nearby IR and shall meet the EMC/EMI requirements of individual equipment and system as a whole. The Contractor shall ensure that due to parallelism hazardous touch potential is not created.

15.4.25 The Outdoor Cables (Jelly Filled Telecom Quad Cable & PIJF Telephone Cables etc.) in sufficient **spare lengths (minimum 10 meters)** shall be kept coiled in a circle of suitable diameter at 1.0 meter depth before being taken into TER/ Location Boxes for termination / either end of the bridges etc. Such coils of cables in pits shall be adequately covered to provide protection against damage and theft.

15.4.26 All the cable entry into TER/ Location Boxes etc. shall be suitably sealed to prevent entry of rodents etc.

15.4.27 Selection of cables and connectors shall be appropriate to their function. The Contractor must be able to demonstrate satisfactory usage of the type of cables proposed for use under tropical conditions, be able to comply fully with the specifications herein.

15.4.28 For Metallic Armour of the Optical Fibre Cable, Jelly Filled Telecom Quad Cable & PIJF Telephone Cables, an earthing and gapping policy shall be incorporated into an overall earthing policy as reviewed by the Engineer.

15.4.29 A correctly coloured fibre splice protector shall be used to enclose each individual splice. Each fibre splice shall be tested to ensure correct fibre continuity and splice loss.

15.4.30 The quad cable used for emergency communication shall also **have 20% (of the total conductors used) spare** conductors.

15.5 IDENTIFICATION

15.5.1 Descriptive labels shall be provided for all cabinets, enclosures, panels, assemblies and sub-assemblies. Labels shall be of engraved type, metallic with durable markings and shall have character size not less than 6 mm high.

15.5.2 The details of the labels including the material and size of the characters and sample of the labels shall be submitted to the Engineer for review.

15.5.3 Labels and notices on equipment shall be fixed with roundhead brass screws or self- tapping screws. Stick-on labels or fixing by adhesive shall not be accepted.

15.5.4 All enclosures containing terminals or exposed live parts where a voltage exceeds 120 volts shall have a label with lettering indicating the maximum voltage present in the enclosure.

15.5.5 Warning signs shall be provided with graphical symbols and wordings in red for hazardous electrical or optical laser equipment.

15.6 MARSHALLING AND TERMINATION

15.6.1 General

15.6.1.1 Main distribution frames, digital distribution frames and optical distribution frames shall be provided at appropriate locations for signal termination, distribution, disconnection, diversion and in-circuit testing. Intermediate termination points shall also be provided as appropriate to allow cable network flexibility.

15.6.1.2 The signal termination and distribution practice shall adopt a consistent approach for easy circuit identification and is subject to the review of the Engineer.

15.6.1.3 The circuit terminations shall be secure enough to withstand vibration level, which is likely to be experienced in the railway environment. These terminations shall be designed to allow repeated circuit termination and disconnection.

15.6.1.4 Jelly Filled Telecom Quad Cable and PIJF Telephone Cables shall be terminated on Disconnection Type Terminal Blocks complying with IEC 60947-7-1. These Terminal Blocks shall be made of Polyamide 6.6 Insulating Material and shall use non-corrosive Metal Parts. These Terminal Blocks shall have provision for identification/number for each termination and shall be securely attached to Mounting Rails.

15.6.1.5 Wherever possible, standard multi-pin plug/socket shall be used to terminate multi-core cables for connecting to the equipment. Heat-shrinkable sleeves shall enclose all exposed and terminated contacts inside multi-pin connectors.

15.6.1.6 All RF Joints outside the cabinets shall be sealed by waterproof tapes or jackets.

15.6.2 Main Distribution Frame

15.6.2.1 Main distribution frame with 20% extra capacity for future expansion shall be provided at Telecommunication Equipment Room for the signal distribution of all voice, analogue, alarm and control circuits.

15.6.2.2 The outgoing circuits connecting to external lines and all circuits affected by lightning or high induced voltage shall be provided with lightning arrestors and surge protection devices with the required earth connections.

15.6.2.3 All voice, analogue, alarm and control circuits including spares shall be properly terminated at the main distribution frame.

15.6.2.4 The main distribution frame shall be divided into different zones for different types of circuits.

15.6.2.5 The main distribution frame shall be equipped with copper earth bar to which all cable shields shall be connected. The copper earth bar shall be connected to the earth.

15.6.2.6 The main distribution frame shall be equipped with facilities such as use of different colours or markers to aid circuit pairs identification.

15.6.2.7 The Contractor shall maintain records of all the circuit terminations.

15.6.3 Digital Distribution Frame

15.6.3.1 Digital distribution frame shall be provided at Telecommunication Equipment Room and at other locations as appropriate for data circuit termination.

15.6.3.2 Different modules in the digital distribution frame shall be provided for different types of data circuits.

15.6.3.3 The digital distribution frame shall be equipped with sufficient capacity for data circuits including spare circuits. The digital distribution frame shall also be equipped with an extra of 20% of termination capacity for future use.

15.6.3.4 Markers or labels shall be included in the digital distribution frame for easy identification of the circuits.

15.6.4 Fibre distribution management system (FDMS)

15.6.4.1 FDMS shall be provided at Telecommunication Equipment Room, and at other locations as appropriate for optical signal distribution. FDMS shall comprise of equipment cabinet(s) or enclosures housing,

- fibre splice module
- fibre storage panel
- optical patch panel

15.6.4.2 All fibre cores terminating in the optical distribution frame shall be spliced to factory manufactured pigtails or properly stored in the fibre storage panel.

15.6.4.3 Optical patch cords shall be provided to connect the optical terminal to the optical distribution frame and for patching within and between optical patch panels.

15.6.4.4 Fibre storage panels shall be provided in the optical distribution frame to stow the excess length of pigtail and patch cords.

15.6.4.5 All splices shall be fusion splices and heat shrink splice sleeves shall be used for splice protection and housed in a fibre splice module.

15.6.4.6 All fibre splice modules shall be either telescopic or hinged type for easy access of splice elements.

15.6.4.7 All fibre splice modules shall be equipped with built-in fibre slack take-up mechanism.

15.6.4.8 All optical distribution panels shall be either telescopic or hinged type for easy access of rear side of panels. The optical distribution panel shall be fully equipped with adapters for optical signal termination.

15.6.4.9 All spare adapters shall be protected with jackets.

15.6.4.10 One high quality optical connector such as LC/FC/PC single mode (SM) 10/125 pm type shall be standardised. Optical connector type specified on the transmission equipment shall be compatible with the optic fibre termination. The coupling loss of the connector shall be below 0.1dB.

15.6.4.11 All optical connectors shall comply with the ITU-T Recommendation G.652.

15.6.4.12 All pigtails and patch cords shall be properly labelled.

15.6.4.13 FDMS shall be equipped with sufficient capacity for all optical signal distribution and fibre storage. An extra of 20% capacity in each module shall be provided for future

expansion.

15.6.4.14 All optical fibre splice configuration at each location shall be designed to fulfil the System fault tolerant requirement.

15.7 EARTHING POLICY

15.7.1 General

15.7.1.1 Earthing shall be provided for all indoor & outdoor Telecommunication installations to achieve the following objectives:

- to provide safety to the operating & maintenance personnel against the electric shock on account of any potential (voltage) appearing on exposed parts with respect to earth or due to electromagnetic or due to electrostatic induction;
- to ensure safe & reliable operation of the equipment by limiting or eliminating the induced voltages and transients in the Telecommunication equipment;
- to protect the equipment against build-up of unduly high voltages, which can cause dielectric (Insulation) breakdown or damage to the equipment or their parts;
- to serve as common voltage reference point wherever required.

15.7.1.2 An earthing system shall be designed to assure personnel safety and protection of installations against damage. It shall also serve as a common voltage reference and to contribute to the mitigation of disturbances.

15.7.1.3 To achieve the primary goal of assuring personnel safety and damage control, a low impedance path shall be made available to the current generated due to lightning or power system fault. The potential differences between any two points shall be as low as possible. Safety considerations also require the chassis or enclosure to be earthed to minimise shock hazards to system staff.

15.7.1.4 To achieve the secondary goal of providing protection for sensitive and interconnected electronic and electrical systems, earthing shall be designed to minimise the noise voltage generated by currents from two or more circuits flowing through common earth impedance and to avoid creating earth loops susceptible to magnetic fields and differences in earth potential.

15.7.1.5 Earthing and other protective measures in the following paragraphs are given only as indicative guidelines. The Contractor shall design, manufacture, install and be responsible for safe and correct working of all equipment/subsystems under the scope of the Contract.

15.7.1.6 The Contractor shall submit, for review and approval the design for earthing, transient protection and lightning protection of all Telecommunication Subsystems including earthing and lightning protection of the VHF mast, telecom equipment etc. OEM's original data sheets of the proposed devices shall also be submitted.

15.7.2 Requirements of effective Earthing

15.7.2.1 The Earthing system shall meet or exceed the requirements of IEEE 1100, NFPA 780, IEC 1024 and ITU-T Recommendation K.27 or relevant International standards.

15.7.2.2 Earthing and other protection devices shall be designed to accomplish the following minimum requirements but not limited to:

- protect personnel and equipment from electrical hazards, including lightning and reduce fire hazards;

- reduce potential to system neutrals;
- enable signalling with earth return;
- reduce or eliminate the effects of electrostatic and electromagnetic interference arising from within the HORC on account of traction voltages, traction return current, electric locomotive characteristics and other extraneous sources;
- minimise service interruptions and equipment damage:
- minimise radiated and conducted electromagnetic emissions:
- reduce radiated and conducted electromagnetic susceptibility:
- improve system tolerance to discharge of electrostatic energy and lightning interference:
- provide a proper earthing method for all equipment enclosures, cabinets, drawers, assemblies and sub-assemblies; and
- provide a clean zero-volt reference point where required.

15.7.2.3 The earthing system shall be so designed as to give earth resistance within the stipulated limits at all locations and under all climatic conditions.

15.7.2.4 Any electrical joints in the earthing system shall be protected from moisture ingress by using proper wrapping, sealing with waterproof tapes, or such other measures.

15.7.2.5 For the purpose of measurement of earth resistance, a small interconnecting copper strip of appropriate cross-section shall be provided in the ring earth in a small manhole chamber so that the ring earth can be broken from the loop.

15.7.2.6 The earthing methods, design and details shall be submitted to the Engineer for review and approval.

15.7.3 Earthing of Indoor Equipment

15.7.3.1 **Main earth bus bar** shall be provided in the power supply room by the Electrical Contractor. The Contractor shall provide minimum **16 mm^2 cable** from the power supply room to the TER/ Telecom power supply room and terminate on copper earthing strips of sufficient size and specifications. These earthing strips shall be used by the Telecommunication Contractor to extend individual earths to cables and racks/equipment etc. for power supply equipment of Telecommunication system.

15.7.3.2 In order to ensure a captive earth connection to the cabinets and racks in TER, a minimum cross-section of **10 mm^2 copper** wire shall be used for earthing.

15.7.3.3 The cabinets within a row are to be conductively connected by means of screws and contact washers. Two or more rows are interconnected via the earth bus and if necessary, also by additional earthing cables. In case that one of the cabinets/racks is removed, it shall be ensured that the other cabinets in the row remain earthed

15.7.3.4 Earthing strips will be connected to a Common Bonding Network (CBN)

15.7.3.5 For telecommunication equipment in TER and Centralised tunnel control center maintenance free ring earth shall be provided with earth value **< 0.5 Ω** for clean earth.

15.7.3.6 For telecommunication equipment in S&T Huts, TSS/SP/SSP and other telecom equipment room etc. maintenance free earth electrode shall be provided with earth value **< 1Ω.**

15.7.4 Earthing of Outdoor Installations

15.10.4.1 Outdoor installation listed below shall be earthed to the nearest **Main earth bus bar** with a minimum **10 mm^2** copper conductor:

- Metallic sheath and armouring of all cables at regular intervals;
- Location boxes;
- Switches
- any other Telecommunication installation as may be necessary to cover complete scope of works defined in the Contract.

15.10.4.2 The Contractor shall also use suitable safety methods such as screen of wire mesh (earthed) for safety of maintenance staff wherever there is infringement of equipment installation in the signal clearance zone as per Indian Railway's Railway Electrification practices.

15.7.5 Earthing Arrangement

15.7.5.1 At Station/TSS/SP/SSP/ S&T Huts separate maintenance free earth electrode shall be provided for earthing of the telecommunication equipment.

15.7.5.2 The earthing system shall meet, but not be limited to, the following:

- The resistance to earth of the system "earth terminal" shall remain within the stipulated limits at all locations and under all climatic conditions.
- Any electrical joints in the earthing system shall be protected from moisture ingress by using proper wrapping, sealing with waterproof tapes, or such other measures.

15.7.5.3 The earthing arrangements for Telecommunication Equipment shall be as below:

- All Telecommunication equipment shall be protected using a mesh of copper "earth" strips of appropriate cross-sectional dimensions, forming a local clean earth bus.
- Each equipment rack shall be connected electrically to this bus. This bus shall be connected to the external ring earth forming a Common Bonding Network (CBN) at the shortest possible distance from two opposite points of this bus.
- All joints of this connection shall be protected from ingress of moisture by using proper wrapping, sealing with water-proof tapes, or such other measures.
- The earthing connection shall be inspected periodically at intervals frequent enough to ensure that the earth connection meets all the requirements.

15.7.5.4 The metallic sheath and armouring of all cables (RF Cables/Optical Fibre Cable/Quad cable/PIJF telephone cable/ Leaky cbales etc.) shall require earthing. In the section earthing shall be done as per the established practices in RE areas of the Indian Railways.

15.7.5.5 The earthing electrodes for the clean earth shall be located at least 20 m away from the main earth.

15.7.5.6 The route for the clean earth shall be so chosen as to minimise the effect of any inductive interference.

15.7.5.7 For the purpose of measurement of earth resistance, a small interconnecting copper strip of appropriate cross-section shall be provided in the ring earth in a small manhole chamber so that the ring earth can be broken from the loop.

15.7.5.8 The earth resistance at any point on the clean earth shall **be below 0.5 Ohm**, and that for the main earth shall not **exceed 1.0 Ohm at any** location and under any soil and/or

climatic condition.

15.7.5.9 All metal work and metallic items shall be earthed to the main earth to ensure the safety of personnel.

15.7.5.10 At every kilometer armour of OFC cable shall be cut for 5cm length and this piece shall be removed and covered by heat shrink tube.

15.7.5.11 The earthing methods and details shall be submitted to the Engineer for review.

15.8 Surge protection devices

It shall be provided at TER End and outdoor equipment End, on power and data cables extending to outdoor telecommunication equipment installations as a minimum as defined below:

15.8.1 Armour of optical fibre cable and Quad cable shall be directly earthed at TER end and earthed through a surge protection device at the other end station;

15.9 Housing, Enclosure and Cabinet

15.9.1 All equipment installed shall be able to withstand vibration levels likely to be experienced in railway stations and along railway track side structures.

15.9.2 All design of housing and enclosure shall be submitted to the Engineer for review.

15.9.3 Unless specified otherwise, all equipment to be housed in outdoor environment (open areas etc.) shall be with IP 65 enclosures as a minimum.

(End of Chapter-15)

CHAPTER 16 - TESTING AND COMMISSIONING

16.1 GENERAL

16.1.1 The Contractor shall perform stage-wise testing and commissioning activities in accordance with the requirements given in this Specification.

16.1.2 The Contractor shall ensure that prior to the commencement of tests; documentation associated with tests has been reviewed No Objection by the Engineer.

16.1.3 The Contractor shall ensure that the Equipment/Subsystem/System is in a state ready for Testing and Commissioning before the commencement of the tests. The Contractor shall conduct Trial tests and satisfy himself before offering the Equipment/Subsystem/System for the tests. Test results of the Contractor's own trial tests shall be made available to the Engineer on demand. This is to indicate the readiness of the Equipment/Subsystem/System for tests.

16.1.4 The Contractor shall provide all necessary Test instruments, Special tools and Test software to carry out the tests.

16.1.5 The Contractor shall extend full support to the Engineer and provide all necessary facilities to enable convenient inspection of materials, work and testing.

16.1.6 The Contractor shall investigate and provide corrective actions for all the faults detected during the tests. The tests shall be resumed only after all the faults are properly cleared. The Contractor shall submit Fault report to the Engineer to describe the symptom and causes of the Faults and the Corrective actions taken.

16.1.7 If the operation of other Project Contractor's system or equipment is suspected to be affected by the system during the test, the Contractor shall withhold the test, investigate and take corrective actions, if necessary, before resumption. The test shall be resumed only after the interference has been eliminated or found not to be related to the System.

16.2 TESTING STAGES

16.2.1 The Contractor shall carry out testing and commissioning activities in the following phases:

- Factory Acceptance Tests;
- Installation Tests;
- System Acceptance Tests;
- Integrated Testing and Commissioning
- Service Trial.

16.3 FACTORY ACCEPTANCE TESTS

16.3.1 The Contractor shall prepare and submit, at least three months before the tests, for review by the Engineer the Factory Acceptance Test Plan, detailing and explaining how the contractor shall plan, perform, and document all inspections and tests that shall be conducted to verify and validate the works prior to delivery to Site. In addition, the Factory Test Plan shall also include the following:

- A list of equipment and cables for individual Subsystems to have Factory Acceptance Test;

- The program of all the activities related to factory acceptance tests;
- The locations where factory acceptance tests to be carried out;
- The estimated duration of tests activities at each location; and
- Submission of schedule of all the factory acceptance test procedures for equipment and cable.
- Submission of specifications and standards, reviewed design documentation for reference for FAT of equipment and cable.

16.3.2 Factory Acceptance Test shall be carried out for equipment and cables of all the Subsystems.

16.3.3 The Contractor shall carry out Factory acceptance tests at the place of manufacturing. The Test shall include, but not be limited to:

- Visual inspection,
- Environmental tests,
- Electrical tests,
- Functional tests and
- Fatigue tests

on each individual equipment and associated Subsystem as well as cables before delivery of the equipment to the Site.

16.3.4 The environmental tests and fatigue tests are not required; if it has already been conducted and independently witnessed previously on similar item and test results are accepted by the Engineer.

16.3.5 The Contractor shall prepare the Factory acceptance test procedures for equipment and cables and shall submit Twenty-Eight **(28) days in advance** of carrying out any Test to the Engineer for review. The Factory acceptance test procedures shall describe in detail all tests to be performed on the equipment and cables along with Pass/Fail criteria (i.e. the standards or limit to be achieved).

16.3.6 The Factory Acceptance Test shall not be started unless the factory acceptance test procedures have been reviewed without objection by the Engineer.

16.3.7 Factory Acceptance Tests shall be witnessed by the Engineer

16.3.8 Where any part of testing is carried out by an independent laboratory, a copy of Test Certificate issued by the relevant authority of that laboratory shall be submitted along with the Factory Acceptance Test Procedure.

16.3.9 The Factory Acceptance Tests are considered completed only if the Engineer without objection reviews the Factory Acceptance Test results.

16.4 INSTALLATION TESTS

16.4.1 Installation Tests shall be carried out on individual Subsystem location by location after the completion of equipment's physical installation. This shall include following tests but not limited to:

16.4.1.1 **Pre-Installation test/Inspection** shall include the verification of FAT/

Quality test report, Invoice, OEM manuals, Warranty certificates etc. RFI shall be submitted for this test/ inspection.

16.4.1.2 **Post installation test** shall include the installation of equipment as per approved drawing, Particular specification etc. Power supply test shall be the part of Post-installation test.

16.4.2 The Objective of the installation tests shall be to ensure the following:

- The equipment is installed in accordance with the reviewed design documentation
- The equipment is installed in accordance with the requirements detailed in this Specification
- All cables are properly and accurately connected and terminated
- All installation works are of acceptable workmanship

16.4.3 The Contractor shall develop procedures for Installation Tests and shall submit to the Engineer for review. The Installation test procedures shall describe in detail all tests to be performed on the equipment and cables along with Pass/Fail criteria (i.e. the standards or limit to be achieved).

- The Installation Test shall not be started unless the installation test procedures have been reviewed without objection by the Engineer.
- All installed equipment and cables shall be physically inspected against all relevant reviewed design documentation.
- The Contractor shall measure the end-to-end performance of all cores of the copper cables and optical fibre cables, including all spare cores, laid between different locations.
- The Contractor shall verify all the connections within the antenna network and measure the attenuation and VSWR values of all the connections.
- All the **installation test results, physical locations of the equipment and serial numbers** shall be captured in the test record forms. The Contractor shall include completed test record forms in the Test Report and submit to the Engineer for review.
- The Installation Tests are considered completed only if the Engineer without objection reviews the Installation Test results.

16.5 SYSTEM ACCEPTANCE TESTS

16.5.1 The Contractor shall carry out System Acceptance Tests after the completion of the Installation Test. System Acceptance test shall include the functional test of all equipment from the **Control centre**.

16.5.2 System Acceptance Tests shall be carried out on individual Subsystem as well as whole System to verify the functional, operational performance, electrical performance and services coverage at the stage:

- after successful completion of the Installation Tests;
- after the Subsystems have been configured with correct settings and parameters;
- properly connected to the power supply and can be switched on for System

Acceptance Tests; and

- before the equipment of different locations are ready for Integrated Testing & Commissioning.

16.5.3 The Contractor shall develop System Acceptance Tests procedures for each Subsystem and System as a whole and submit to the Engineer for review.

16.5.4 The System Acceptance Tests procedueres shall include:

- Objectives of the System Acceptance Tests for all subsystems;
- Objectives of the System Acceptance Tests for system as a whole;
- Specifications and standards, reviewed design documentation for reference;
- Step-by-step test instructions;
- Test instrument and special tools;
- Test record forms; and
- Pass or fail criteria.

16.5.5 Where performance across interfaces to other System within this Contract is required to be verified during the System Acceptance Tests, the Contractor shall include **a list of other systems and the interface test procedures** in the System Acceptance Tests procedures for the relevant Subsystem.

16.5.6 Where performance across interfaces to Project Contractors or to other parties is required to be verified during the System Acceptance Tests, the Contractor shall include a list of Project Contractors and the interface test procedures agreed with the relevant Project Contractors in the System Acceptance Tests procedures for the relevant Subsystem.

16.5.7 The functional, electrical and timing performances of the Subsystems as well as System as a whole shall be verified against the requirements and relevant national/ international standards.

16.5.8 The Contractor shall conduct end-to-end circuit test to verify the circuit integrity and electrical performance for all circuits including spare.

16.5.9 All local alarms, control and monitoring functions shall be verified.

16.5.10 All equipment settings and parameters shall be verified and recorded in the reviewed test record forms.

16.5.11 All protection mechanisms such as **hot-standby, parallel redundancy, automatic switchover** etc. built into the system and individual Subsystems shall be verified.

16.5.12 The **system response time** of relevant Subsystems and the System shall be tested and measured.

16.5.13 The Contractor shall carry out **load test** on each Subsystem to verify the designed system capacity and performance in accordance with the requirements given in the Particular Specification under full load condition.

16.5.14 The Contractor shall carry out tests on the operation of the System in accordance with the **normal operation procedures** and **emergency operation procedures**, which has been reviewed with No objection by the Engineer.

16.5.15 The System Acceptance Tests are considered completed only if the Engineer with No objection reviews the System Acceptance Test results.

16.5.16 Upon completion of the System Acceptance Test, the individual Subsystem shall be operational and shall be ready to be connected to other Subsystems and interfacing systems for testing.

16.6 INTEGRATED TESTING AND COMMISSIOING

16.6.1 The Contractor shall carry out Integrated Testing and Commissioning after the completion of the System Acceptance Tests. This test shall include the test of equipment from the IMD/ Control Centre of the project.

16.6.2 The Contractor shall co-ordinate with the Engineer and with all the interfacing Project Contractors/ Parties to ensure all the interface test activities are completed in accordance with the program on **Completion Plan**.

16.6.3 The Contractor shall provide all necessary supports, conduct investigation and provide corrective actions, if necessary, to ensure all matters related to interfacing are properly resolved.

16.6.4 Within one week upon completion of all interface test activities, the Contractor shall submit the test results to the Engineer for review.

16.6.5 After the test results of all interface test activities have been reviewed by the Engineer without objection, the Contractor shall start the Reliability Demonstration Test in accordance with the reviewed Reliability Demonstration Test Plan.

16.6.6 The Contractor shall advise the Engineer in writing the commencement date of the Reliability Demonstration Test.

16.6.7 The Contractor shall submit a Reliability Demonstration Test Plan to the Engineer for review **at least three months before** the test.

16.6.8 The Contractor shall include the following in the Reliability Demonstration Test Plan as a minimum:

- calculation of the maximum allowable number of failures of equipment, Subsystems and System during the reliability demonstration period in accordance with requirements on reliability performance of the equipment, Subsystems and System given in the Particular Specification
- definition of relevant failures
- pass and fail criteria
- sample of fault logs

16.6.9 During the reliability demonstration test period, the Contractor shall record details of all faults in a fault log which shall include:

- the date and time the fault occurs
- the date and time the Contractor's staff arrive on site
- the date and time the fault is cleared and the normal operation is restored
- the description of the fault
- the cause of the fault
- equipment or component replaced

16.6.10 All fault logs shall be submitted to the Engineer for review.

16.6.11 The reliability demonstration test is considered a failure if:

- the actual number of relevant failures exceeds the maximum allowable number of failures for any equipment, Subsystems or System identified in the Reliability Demonstration Test Plan
- any fault resulting from the Design omission or commission of error requires Design modification in order to fix the fault

16.6.12 If the reliability demonstration test fails, the Contractor shall provide all the necessary corrective actions and rectify the fault to the satisfaction of the Engineer.

16.6.13 The reliability demonstration test shall be repeated on the affected Subsystem or Subsystems for another three months until the test is successfully completed.

16.6.14 Within two weeks upon completion of the reliability demonstration test, the Contractor shall submit the test results for the Engineer to review.

16.6.15 The Integrated Testing and Commissioning is considered completed only if all the test results of the Integrated Testing and Commissioning have been reviewed by the Engineer with No objection.

16.7 SERVICE TRAILS

16.7.1 The Contractor shall provide all necessary support and attendance to the Engineer during the Service Trials period.

16.7.2 The Contractor shall provide on-Site supports to the Engineer in all aspects related to the operation of the System. The Contractor shall also conduct investigation and provide corrective actions for any problems related to the System or the interfaces with the System.

16.7.3 The Contractor shall assign competent staff to support the Service Trials as required by the Engineer. The persons shall be the technical staff who shall have sufficient skills and knowledge of the System and shall have been involved in the Design, installation or commissioning of the System.

16.7.4 The Contractor shall submit a Manpower Plan to the Engineer for review at least 1 month before the commencement of the Service Trials.

16.7.5 The manpower plan shall include the organisation chart of the Contractor's Service Trials supporting group, individual person's role and responsibility and 24-hour contacts for emergency cases.

(End of Chapter-16)

CHAPTER 17 - SPARES, SPECIAL TOOLS AND TEST EQUIPMENT

17.1 SPARES

17.1.1 **General:** The Contractor shall provide his own spares during Installation & Commissioning Period as well as during the Defects Notification Period. The Contractor shall also provide separate spares for the Employer to enable the Employer to operate and maintain the System.

17.1.2 Contractor's Own Spares

17.1.2.1 The Contractor shall keep and maintain sufficient stock of his own Installation & Commissioning Spares and Defects Liability Spares. In addition, in determining the list of spare parts for the Installation & Commissioning Spares and Defects Liability Spares, the Contractor shall provide calculation to support the proposed spares and quantities with the following taken into account:

- the expected failure rate of the parts;
- population of the parts in the System;
- criticality of the parts in the System;
- availability figures of the System;
- spare delivery lead time; and
- workshop repair turnaround time.

17.1.2.2 The Contractor shall submit the list of Installation & Commissioning Spares, with the types and quantities of spares, the Contractor intends to **hold at least three months** before the commencement of installation activity to the Engineer for review.

17.1.2.3 The Contractor shall submit the list of Defects Liability Spares with the types and quantities of spares. The Contractor intends to hold **at least six months before** the commencement of the Defects Notification Period to the Engineer for review.

17.1.2.4 The Contractor shall include details of the stock of the Contractor's own spares in the Monthly Progress Report. The status of the spares, either in store or under workshop repair, shall also be included.

17.1.3 **Contract Spares** for Employer's Operational and Maintenance Requirements

17.1.3.1 The Contract Spares to be supplied by Contractor to Employer for Employer's Operational and Maintenance Requirements shall include **spare modules, sub-assemblies, special components, cables, connectors, fuses** etc. The Contract Spares to be supplied shall be as per the following list but not limited to:

S.No.	Item	Total Quantity
1.	Layer-2 Switch	10% of the total population for each type
2.	Analogue Telephone Instruments	10% of the total population for each type
3.	Station Sub-Master Clock Complete	10% of the total population

4.	Replaceable/Plug-In Cards for Power supply system	10% of the total population for each type
5.	Maintenance Free Batteries	10% of the total population for each type
6.	Fuses of all types	10% of the total population for each type
7.	Terminals of all types	10% of the total population for each type
8.	Transient/ Surge Protection Device	10% of the total population for each type
9.	Fibre distribution management system	10% of the total population
10.	Telephone Cable Termination box	10% of the total population
11.	Thermo shrink Jointing Kits for all sizes of Telecommunication cables	10% of the total population
12.	Optical Fibre Cable	10% of the total population (Km)
13.	Optical Fibre Splice Box & remake loops	10% of the total population
14.	Optical Pigtail Cables and Optical Patch cords	10% of the total population for each type
15.	10 Pair PIJF Cable	10% of the total population(km)
16.	Indoor Telephone Cable (CAT 6, Switch board, LAN cable)	10% of the total population (km) for each type.
17.	6 QUAD CABLE	10% of the total population(Km)
18.	All type of Connectors/ Dummy Loads	10% of the total population for each type.
19.	Emergency Socket	20% of the total population for each type.

20.	Portable Emergency Telephone Set	10% of the total population
21.	4 Wire DTMF Control way station equipment	10% of the total population
22.	4 Wire DTMF Control Telephone	10% of the total population
23.	Any other equipment/ Replaceable/Plug-In Cards	10% of the total population for each type

NOTE:

i) The Quantity shall be rounded to nearest decimal natural number with minimum1(One).

ii) The Contractor shall submit list the of Contract Spares along with quantities at least **6 months before** start of 'Defects Notification Period', based on approved tentative BOQ which shall be adjusted on approval of As-Built BOQ.

iii) The list of Contract Spares shall include information such as **brand name, model number, serial number (if applicable), rating(if applicable), description, part number(if applicable), drawing number, shelf life, bar-coded (as directed by the Employer**) etc. of each item of Contract Spares.

iv) The Contractor shall indicate the **sources of supply** of each item of Contract Spares and shall **guarantee** their availability during the service life of the system.

v) All Contract Spares shall be tested as per reviewed **factory acceptance testing procedures** before delivery to the Employer. The delivery to the Employer shall be completed by the **start** of 'Defects Notification Period'.

vi) Any item not included as Contract Spare and subsequently found to be necessary during Defects Notification Period, shall be supplied by the Contractor in required quantities as variation to Contract under direction of Engineer.

17.2 CODING AND TAGGING OF SPARE PARTS AND SPECIAL TOOLS AND TEST EQUIPMENT

All Spares/Spare Parts and Special Tools and Test Equipment to be delivered to the Employer shall each carry a tag suitably marked, bar-coded (as directed by the Engineer) and numbered. The numbers on the tags shall correspond with those on the coding system developed by the Contractor for all Telecom components, parts and equipment.

17.3 SPECIAL TOOLS AND TEST EQUIPMENT

17.3.1 The Contractor shall provide his own test equipment and tools during the Installation & Commissioning Periods and Defects Notification Period.

17.3.2 The following Special Tools & Test Equipment but not limited to shall be suitably packed

and supplied to the Employer:

S.No.	Item	Unit	Total Quantity
1.	Portable digital auto range Multimeter, Philips/ Fluke or similar make capable to measure from 0.1 mV / 0.01 mA AC/DC up to 10 Amp. AC/DC, 600 V AC/DC and resistance from 0.1 Ohms to 40 M Ohms complete.	Number	2
2.	Digital earth tester, 4 terminal, range 0-10/ 100 ohms with rechargeable battery complete with other required accessories in a suitable carrying case.	Number	1
3.	Megger 500 Volts and 100 Volts 0 to 200 M ohms with earth tester, electronic push button type of Philips or any otherreputed make	Number	1 each
4.	Optical Power Meter with Laser Source (2 in 1)	Number	1
5.	Optical Variable Attenuator (1 Db to 10 Db)	Number	2 each type
6.	Udnderground Cable jointing tool kit	Number	1
7.	Emergency light	Number	2
8.	General purpose telecom tool kit.	Number	2
9.	• Tools for circuits connection and disconnection • Plug-in devices for circuit disconnection • Test cords and loop-back cords • Signal patch cords	Number	A least one sets of the accessories at each location where the Main distribution frame (MDF) and Digital distribution frame (DDF) is installed.

17.3.3 The Contractor shall submit the **technical specifications, datasheets, operation manuals, complete diagrams, schematics, assembly and connection drawings, maintenance instructions and calibration certificates** of each type of Special Tool & Test Equipment at least **six months before** the start of Defects Notification Period to the Engineer for review.

17.3.4 All Special Tools & Test Equipment shall be supplied together with all **cords, connectors and batteries**.

17.3.5 None of the Special Tools & Test Equipment provided for the Employer shall be used on site prior to delivery to the Employer.

17.3.6 The supply of Special Tool & Test Equipment shall be completed by the **start of Defect Notification Period**.

17.3.7 All tools and test equipment required in the field for restoration of the network shall be suitably fixed with cover in the **maintenance vehicle (Mobile Telecommunication maintenance vehicle)**, so that in case of failures, the mobilisation time is minimised and complete equipment required for repair are carried by the maintenance vehicle.

(End of Chapter-17)

Section 6

General Conditions of Contract (GCC)

Section 6 –General Conditions of Contract

Table of Clauses

General Conditions

1. General Provisions

1.1 Definitions In the Conditions of Contract ("these Conditions"), which include Special Conditions of Contract, Parts A and B, and these General Conditions, the following words and expressions shall have the meanings stated. Words indicating persons or parties include corporations and other legal entities, except where the context requires otherwise.

1.1.1 The Contract

1.1.1.1 "**Contract**" means the Contract Agreement, the Letter of Acceptance, the Letter of Bid, these Conditions, the Specification, the Drawings, the Schedules, and the further documents (if any) which are listed in the Contract Agreement or in the Letter of Acceptance.

1.1.1.2 "**Contract Agreement"** means the contract agreement (*if any*) **referred** to in Sub-Clause 1.6 [Contract Agreement].

1.1.1.3 **"Letter of Acceptance**" means the letter of formal acceptance, signed by the Employer, of the Letter of Bid, including any annexed memoranda comprising agreements between and signed by both Parties. If there is no such letter of acceptance, the expression "Letter of Acceptance" means the Contract Agreement and the date of issuing or receiving the Letter of Acceptance means the date of signing the Contract Agreement.

1.1.1.4 **"Letter of Bid"** means the document entitled letter of bid, which was completed by the Contractor and includes the signed offer to the Employer for the Works.

1.1.1.5 **"Specification**" means the document entitled specification, as included in the Contract, and any additions and modifications to the specification in accordance with the Contract. Such document specifies the Works.

1.1.1.6 **"Drawings"** means the drawings of the Works, as included in the **Contract**, and any additional and modified drawings issued by (or on behalf of) the Employer in accordance with the Contract.

1.1.1.7 **"Schedules"** means the document(s) entitled schedules, completed by the Contractor and submitted with the Letter of Bid, as included in the Contract. Such document may include the Bill of Quantities, data, lists, and schedules of rates and/or prices.

1.1.1.8 **"Bid/Tender"** means the Letter of Technical Bid **and**Letter of Price Bid and all other documents which the Contractor submitted with the Letter of Technical Bid and Letter of Price Bid , as included in the Contract.

1.1.1.9 **"Bill of Quantities"** and **"Daywork Schedule**" and "Schedule of Payment Currencies" mean the documents so named (if any) which are comprised in the Schedules.

1.1.1.10 **"Contract Data"** means the pages completed by the Employer entitled contract data which constitute Part A of the Special Conditions of Contract.

1.1.1.11 **"Employer's Requirements"** means the document entitled 'Employer's Requirements' as part of Works Requirements and as included in the Contract, and any additions and modifications to such document in accordance with the Contract. Such document specifies the purpose, scope, and/or design and/or other technical criteria, for the works.

1.1.2 Parties and Persons

1.1.2.1 **"Party"** means the Employer or the Contractor, as the context requires.

1.1.2.2 **"Employer"** means the person named as employer in the Contract Data and the legal successors in title to this person.

1.1.2.3 **"Contractor"** means the person(s) named as contractor in the Letter of Bid accepted by the Employer and the legal successors in title to this person(s).

1.1.2.4 **"Engineer"** means the person nominated by the Employer to act as the Engineer for the purposes of the Contract and named in the Contract Data, or other person appointed from time to time by the Employer and notified to the Contractor under Sub-Clause 3.4 [Replacement of the Engineer].

1.1.2.5 **"**Contractor's **Representative"** means the person named by the Contractor in the Contract or appointed from time to time by the Contractor under Sub-Clause 4.3 [Contractor's Representative], who acts on behalf of the Contractor.

1.1.2.6 "Employer's **Representative"** means the person named by the Employer in the Contract or appointed from time to time by the Employer who acts on behalf of the Employer.

1.1.2.7 **"Employer's Personnel"** means the Engineer, the assistants referred to in Sub-Clause 3.2 [Delegation by the Engineer] and all other staff, labour and other employees of the Engineer and of the Employer; and any other personnel notified to the Contractor, by the Employer or the Engineer, as Employer's Personnel.

1.1.2.8 **"Contractor's Personnel"** means the Contractor's Representative and all personnel whom the Contractor utilises on Site, who may include the staff, labour and other employees of the Contractor and of each Subcontractor; and any other personnel assisting the Contractor in the execution of the Works.

1.1.2.9 **"**Subcontractor**"** means any person named in the Contract as a subcontractor, or any person appointed as a subcontractor, for a part of the Works; and the legal successors in title to each of these persons.

1.1.3 Dates, Tests, Periods and Completion

1.1.3.1 **"Base Date"** means the date 28 days prior to the deadline for submission of bids.

1.1.3.2 **"**Commencement **Date**" means the date notified under Sub-Clause 8.1 [Commencement of Works].

1.1.3.3 **"Time for Completion"** means the time for completing the Works or a Section (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 8.4 [Extension of Time for Completion]), calculated from the Commencement Date.

1.1.3.4 **"Tests on Completion"** means the tests which are specified in the Contract or agreed by both Parties or instructed as a Variation, and which are carried out under Clause 9 [Tests on Completion] before the Works or a Section (as the case may be) are taken over by the Employer.

1.1.3.5 **"Taking-Over Certificate"** means a certificate issued under Clause 10 [Employer's Taking Over].

1.1.3.6 **"Tests after Completion"** means the tests (if any) which are specified in the Contract and which are carried out in accordance with the Specification after the Works or a Section (as the case may be) are taken over by the Employer.

1.1.3.7 **"Defects Notification Period"** means the period for notifying defects in the Works or a Section (as the case may be) under Sub-Clause 11.1 [Completion of Outstanding Work and Remedying Defects], as stated in the Contract Data (with any extension under Sub-Clause 11.3 [Extension of Defects Notification Period]), calculated from the date on which the Works or Section is completed as certified under Sub-Clause 10.1 [Taking Over of the Works and Sections].

1.1.3.8 **"Performance Certificate"** means the certificate issued under Sub-Clause 11.9 [Performance Certificate].

1.1.3.9 "**Day"** means any (working or non-working) calendar day from 00:00 hrs. to 24:00 hrs.

1.1.3.10 **"Months"** means any calendar month of the Gregorian calendar year.

1.1.3.11 **"Year"** means 365 days

1.1.3.12 "**Time** Periods" Any reference to time period commencing "from" the specified day or date "till" or "until" a specified day shall include both such days.

1.1.3.13 Any reference to **"Time"** shall be according to Indian Standard Time (IST).

1.1.4 Money and Payments

1.1.4.1 "**Accepted Contract Amount"** means the amount accepted in the Letter of Acceptance for the execution and completion of the Works and the remedying of any defects. In the Letter of Acceptance, the Accepted Contract Amount shall have two components i.e. (i) the base amount excluding GST (ii) GST component (calculated at the rate for works contract service as per GST Laws).

1.1.4.2 **"Contract Price"** means the price defined in Sub-Clause 14.1 [The Contract Price], and includes adjustments in accordance with the Contract.

1.1.4.3 **"Cost"** means all expenditure reasonably incurred (or to be incurred) by the Contractor, whether on or off the Site, including overhead and similar charges, but does not include profit.

1.1.4.4 **"Final** Payment **Certificate"** means the payment certificate issued under Sub-Clause 14.13 [Issue of Final Payment Certificate].

1.1.4.5 **"Final Statement"** means the statement defined in Sub-Clause 14.11 [Application for Final Payment Certificate].

1.1.4.6 **"Foreign Currency"** means a currency in which part (or all) of the Contract Price is payable, but not the Local Currency.

1.1.4.7 **"Interim Payment Certificate**" means a payment certificate issued under Clause 14 [Contract Price and Payment], other than the Final Payment Certificate.

1.1.4.8 **"Local Currency"** means the currency in Indian Rupees.

1.1.4.9 **"Payment Certificate"** means a payment certificate issued under Clause 14 [Contract Price and Payment].

1.1.4.10 **"Provisional Sum"** means a sum (if any) which is specified in the Contract as a provisional sum, for the execution of any part of the Works or for the supply of Plant, Materials or services under Sub-Clause 13.5 [Provisional Sums].

1.1.4.11 **"Retention Money"** means the accumulated retention moneys which the Employer retains under Sub-Clause 14.3 [Application for Interim Payment Certificates] and pays under Sub-Clause 14.9 [Payment of Retention Money].

1.1.4.12 **"Statement"** means a statement submitted by the Contractor as part of an application, under Clause 14 [Contract Price and Payment], for a payment certificate.

1.1.5 Works and Goods

1.1.5.1 **"Contractor's Equipment**" means all apparatus, machinery, vehicles and other things required for the execution and completion of the Works and the remedying of any defects. However, Contractor's Equipment excludes Temporary Works, Employer's Equipment (if any), Plant, Materials and any other things intended to form or forming part of the Permanent Works.

1.1.5.2 **"Goods"** means Contractor's Equipment, Materials, Plant and Temporary Works, or any of them as appropriate.

1.1.5.3 **"Materials"** means things of all kinds (other than Plant) intended to form or forming part of the Permanent Works, including the supply-only materials (if any) to be supplied by the Contractor under the Contract.

1.1.5.4 **"Permanent Works"** means the permanent works to be executed by the Contractor under the Contract.

1.1.5.5 **"Plant"** means the apparatus, machinery and vehicles intended to form or forming part of the Permanent Works.

1.1.5.6 **"Section**" means a part of the Works specified in the Contract Data as a Section (if any).

1.1.5.7 **"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.

1.1.5.8 **"Works"** mean the Permanent Works and the Temporary Works, or either of them as appropriate.

1.1.6 Other Definitions

1.1.6.1 **"Contractor's** Documents" means the calculations, computer programs and other software, drawings, manuals, models and other documents of a technical nature (if any) supplied by the Contractor under the Contract.

1.1.6.2 **"Country**" means India, the country in which the Site (or most of it) is located, where the Permanent Works are to be executed.

1.1.6.3 **"Employer's Equipment**" means the apparatus, machinery and vehicles (if any) made available by the Employer for the use of the Contractor in the execution of the Works, as stated in the Specification; but does not include Plant which has not been taken over by the Employer.

1.1.6.4 **"Force Majeure**" is defined in Clause 19 [Force Majeure].

1.1.6.5 **"Laws"** means all national (or state) legislation, statutes, ordinances and other laws, and regulations and by-laws of any legally constituted public authority.

1.1.6.6 **"Performance Security**" means the security (or securities, if any) under Sub-Clause 4.2 [Performance Security].

1.1.6.7 **"Site"** means the places where the Permanent Works are to be executed and to which Plant and Materials are to be delivered, and any other places as may be specified in the Contract as forming part of the Site.

1.1.6.8 **"Unforeseeable**" means not reasonably foreseeable and against which adequate preventive precautions could not reasonably be taken by an experienced contractor by the date for submission of the Bid.

1.1.6.9 **"Variation**" means any change to the Works, which is instructed or approved as a variation under Clause 13 [Variations and Adjustments].

1.1.6.10 **"Railway"** means a railway, or any portion of a railway for public carriage of passengers and goods as defined in the Railways ACT 1989. Any reference to railway means the Indian Railways and the respective Zonal Railway

1.2 Interpretation

In the Contract, except where the context requires otherwise:

(a) words indicating one gender include all genders;

(b) words indicating the singular also include the plural and words indicating the plural also include the singular;

(c) provisions including the word "agree," "agreed" or "agreement" require the agreement to be recorded in writing;

(d) "written" or "in writing" means hand-written, type-written, printed or electronically made, and resulting in a permanent record; and

(e) the word "tender" is synonymous with "bid", and "tenderer" with "bidder" and the words "tender documents" with "bidding documents"

The marginal words and other headings shall not be taken into consideration in the interpretation of these Conditions.

In these Conditions, provisions including the expression "Cost plus profit" require this profit to be one twentieth (5%) of this Cost unless otherwise indicated in the Contract Data.

1.3 Communications

Wherever these Conditions provide for the giving or issuing of approvals, certificates, consents, determinations, notices, requests and discharges, these communications shall be:

(a) in writing and delivered by hand (against receipt), sent by mail or courier, or transmitted using any of the agreed systems of electronic transmission as stated in the Contract Data; and

(b) delivered, sent or transmitted to the address for the recipient's communications as stated in the Contract Data. However:

(i) if the recipient gives notice of another address, communications shall thereafter be delivered accordingly; and

(ii) if the recipient has not stated otherwise when requesting an approval or consent, it may be sent to the address from which the request was issued.

Approvals, certificates, consents and determinations shall not be unreasonably withheld or delayed. When a certificate is issued to a Party, the certifier shall send a copy to the other Party. When a notice is issued to a Party, by the other Party or the Engineer, a copy shall be sent to the Engineer or the other Party, as the case may be.

1.4 Law and Language

The Contract shall be governed by the law of the country or other jurisdiction stated in the Contract Data.

The ruling language of the Contract shall be that stated in the Contract Data.

The language for communications shall be that stated in the Contract Data. If no language is stated there, the language for communications shall be the ruling language of the Contract.

1.5 Priority of Documents

The documents forming the Contract are to be taken as mutually explanatory of one another. For the purposes of interpretation, the priority of the documents shall be in accordance with the following sequence:

(a) the Contract Agreement (if any),

(b) the Letter of Acceptance,

(c) the Letter of bid,

(d) the Schedules (including Priced Bill of Quantities),

(e) Special Conditions of Contract:

(i) Part A – Contract Data

(ii) Part B - Specific Provisions

(f) the General Conditions of Contract

(g) Works/Employer's Requirements,

(h) the Drawings,

(i) any other documents forming part of the Contract including minutes of prebid meeting.

If an ambiguity or discrepancy is found in the documents, the Engineer shall issue any necessary clarification or instruction.

1.6 Contract Agreement

The Parties shall enter into a Contract Agreement within 28 days after the Contractor receives the Letter of Acceptance, unless they agree otherwise. The Contract Agreement shall be based upon the form annexed to the Special Conditions of Contract. The costs of stamp duties and similar charges (if any) imposed by law in connection with entry into the Contract Agreement shall be borne by the Employer.

1.7 Assignment

Neither Party shall assign the whole or any part of the Contract or any benefit or interest in or under the Contract. However, either Party:

(a) may assign the whole or any part with the prior agreement of the other Party, at the sole discretion of such other Party, and

(b) may, as security in favour of a bank or financial institution, assign its right to any moneys due, or to become due, under the Contract.

1.8 Care and Supply of Documents

The Specification and Drawings shall be in the custody and care of the Employer. Unless otherwise stated in the Contract, two copies of the Contract and of each subsequent Drawing shall be supplied to the Contractor, who may make or request further copies at the cost of the Contractor.

Each of the Contractor's Documents shall be in the custody and care of the Contractor, unless and until taken over by the Employer. Unless otherwise stated in the Contract, the Contractor shall supply to the Engineer six copies of each of the Contractor's Documents.

The Contractor shall keep, on the Site, a copy of the Contract, publications named in the Specification, the Contractor's Documents (if any), the Drawings and Variations and other communications given under the Contract. The Employer's Personnel shall have the right of access to all these documents at all reasonable times.

If a Party becomes aware of an error or defect in a document which was prepared for use in executing the Works, the Party shall promptly give notice to the other Party of such error or defect.

1.9 Delayed Drawings or Instructions

The Contractor shall give notice to the Engineer whenever the Works are likely to be delayed or disrupted if any necessary drawing or instruction is not issued to the Contractor within a particular time, which shall be reasonable. The notice shall include details of the necessary drawing or instruction, details of why and by when it should be issued, and details of the nature and amount of the delay or disruption likely to be suffered if it is late.

If the Contractor suffers delay and/or incurs Cost as a result of a failure of the Engineer to issue the notified drawing or instruction within a time which is reasonable and is specified in the notice with supporting details, the Contractor shall give a further notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost , which shall be included in the Contract Price.

After receiving this further notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

However, if and to the extent that the Engineer's failure was caused by any error or delay by the Contractor, including an error in, or delay in the submission of, any of the Contractor's Documents, the Contractor shall not be entitled to such extension of time, Cost or profit

1.10 Employer's Use of Contractor's Documents

As between the Parties, the Contractor shall retain the copyright and other intellectual property rights in the Contractor's Documents and other design documents made by (or on behalf of) the Contractor.

The Contractor shall be deemed (by signing the Contract) to give to the Employer a non-terminable transferable non-exclusive royalty-free licence to copy, use and communicate the Contractor's Documents, including making and using modifications of them. This licence shall:

(a) apply throughout the actual or intended working life (whichever is longer) of the relevant parts of the Works,

(b) entitle any person in proper possession of the relevant part of the Works to copy, use and communicate the Contractor's Documents for the purposes of completing, operating, maintaining, altering, adjusting, repairing and demolishing the Works, and

(c) in the case of Contractor's Documents which are in the form of computer programs and other software, permit their use on any computer on the Site and other places as envisaged by the Contract, including replacements of any computers supplied by the Contractor.

The Contractor's Documents and other design documents made by (or on behalf of) the Contractor shall not, without the Contractor's consent, be used, copied or communicated to a third party by (or on behalf of) the Employer for purposes other than those permitted under this Sub-Clause.

1.11 Contractor's Use of Employer's Documents

As between the Parties, the Employer shall retain the copyright and other intellectual property rights in the Specification, the Drawings and other documents made by (or on behalf of) the Employer. The Contractor may, at his cost, copy, use, and obtain communication of these documents for the purposes of the Contract. They shall not, without the Employer's consent, be copied, used or communicated to a third party by the Contractor, except as necessary for the purposes of the Contract.

1.12 Confidential Details

The Contractor shall disclose all such confidential and other information as the Engineer may reasonably require in order to verify the Contractor's compliance with the Contract.

The Contractor shall treat the details of the Contract as private and confidential, except to the extent necessary to carry out the Contractor's obligations under the Contract or to comply with applicable Laws. The Contractor shall not publish or disclose any particulars of the Works without the previous agreement of the Employer. However, the Contractor shall be permitted to disclose any publicly available information, or information otherwise required to establish his qualifications to compete for other projects.

1.13 Compliance with Laws

The Contractor shall, in performing the Contract, comply with applicable Laws. Unless otherwise stated in the Special Conditions of Contract:

(a) the Employer shall have obtained (or shall obtain) the planning, zoning or similar permission for the Permanent Works, and any other permissions described in the Specification as having been (or being) obtained by the Employer; and the Employer shall indemnify and hold the Contractor harmless against and from the consequences of any failure to do so; and

(b) the Contractor shall give all notices, pay all taxes, duties and fees, and obtain all permits, licences and approvals, as required by the Laws in relation to the execution and completion of the Works and the remedying of any defects; and the Contractor shall indemnify and hold the Employer harmless against and from the consequences of any failure to do so.

1.14 Joint and Several Liability

If the Contractor constitutes (under applicable Laws) a joint venture of two or more persons/firms:

(a) these persons shall be deemed to be jointly and severally liable to the Employer for the performance of the Contract;

(b) these persons shall notify the Employer of their leader who shall have authority to bind the Contractor and each of these persons; and

(c) the Contractor shall not alter its composition or legal status without the prior consent of the Employer.

(d) In the event of default by any partner of joint venture, on or after achieving 25% of the financial progress (excluding advance if any) the lead partner or remaining partner(s), in case the defaulting partner is the lead partner, shall notify the Employer within twenty eight (28) days of the occurrence and within Fifty six (56) days of the said notification, the lead partner or remaining partner(s), who are not the defaulting partner, shall assign the works of the defaulting partner, to equally competent party with prior consent of the Employer. For this purpose the term “equally competent party” shall mean as under:

> “The new JV partner replacing the defaulting partner should meet the EQC requirement of package/combination of packages which was met by the defaulting partner on the basis of which the original tender was awarded.”

The replacement of any defaulting partner, with the new partner shall be subject to the condition that the new partner has to submit additional performance security equal to 10% of balance cost of work of the JV partner being replaced. The performance security submitted by the defaulting partner shall also continue with EMPLOYER till satisfactory completion of the work.

(e) Notwithstanding the consent of the Employer for change in composition or legal status of the joint venture the partners shall continue to be jointly and severally liable to the Employer.

(f) The joint venture shall enter into a joint venture agreement incorporating the provisions of sub-paras (a) to (e) based upon the form annexed to the Conditions of

Contract. The JV agreement shall indicate precisely the specific role of all members of the JV in respect of planning, design, construction equipment, key personnel, work execution, and financing of the project. The authority to sign the agreement shall be evidenced by approved legal instruments.

Notwithstanding the contents of the sub-clauses above, if the performance of any JV partner is not found satisfactory by the Employer, in respect of the responsibilities assigned to him as per JV agreement which is a part of this agreement, the Employer may issue notice of such default to the said JV partner or the JV (depending upon reasons of default) and declare the said JV partner or the JV as Poor Performer. The issue of such notice shall automatically debar the JV partner or JV as the case may be from participating in any EMPLOYER tender from the date of issue of notice of default.

1.15 Inspections by the Employer

The Contractor shall permit the Employer and/or persons appointed by the Employer to inspect the Site and/or the Contractor's records relating to the performance of the Contract.

2. The Employer

2.1 Right of Access to the Site

The Employer shall give the Contractor right of access to, and possession of, all parts of the Site within the time (or times) stated in the Contract Data. The right and possession may not be exclusive to the Contractor. If, under the Contract, the Employer is required to give (to the Contractor) possession of any foundation, structure, plant or means of access, the Employer shall do so in the time and manner stated in the Specification. However, the Employer may withhold any such right or possession until the Performance Security has been received.

If no such time is stated in the Contract Data, the Employer shall give the Contractor right of access to, and possession of, the Site within such times as may be required to enable the Contractor to proceed in accordance with the programme submitted under Sub-Clause 8.3 [Programme].

If the Contractor suffers delay as a result of a failure by the Employer to give any such right or possession within such time, the Contractor shall give notice to the Engineer and shall be entitled to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) new rates in terms of clause 12.3.1 (c) .

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

However, if and to the extent that the Employer's failure was caused by any error or delay by the Contractor, including an error in, or delay in the submission of, any of the Contractor's Documents, the Contractor shall not be entitled to such extension of time or new rates.

2.2 Permits, Licenses or Approvals

The Employer shall (where he is in a position to do so) provide reasonable assistanceto the Contractor at the request of the Contractor:

(a) by obtaining copies of the Laws of the Country which are relevant to the Contract but are not readily available, and

(b) for the Contractor's applications for any permits, licences or approvals required by the Laws of the Country:

(i) which the Contractor is required to obtain under Sub-Clause 1.13 [Compliance with Laws],

(ii) for the delivery of Goods, including clearance through customs, and

(iii) for the export of Contractor's Equipment when it is removed from the Site.

2.3 Employer's Personnel

The Employer shall be responsible for ensuring that the Employer's Personnel and the Employer's other contractors on the Site:

(a) co-operate with the Contractor's efforts under Sub-Clause 4.6 [Co-operation], and

(b) take actions similar to those which the Contractor is required to take under sub-paragraphs (a), (b) and (c) of Sub-Clause 4.8 [Safety Procedures] and under Sub-Clause 4.18 [Protection of the Environment].

2.4 Employer's Financial Arrange-ments

The Employer has sourced the funds to finance the project.

2.5 Employer's Claims

If the Employer considers himself to be entitled to any payment under any Clause of these Conditions or otherwise in connection with the Contract, and/or to any extension of the Defects Notification Period, the Employer or the Engineer shall give notice and particulars to the Contractor. However, notice is not required for payments due under Sub-Clause 4.19 [Electricity, Water and Gas], under Sub-Clause 4.20 [Employer's Equipment and Free-Issue Material], or for other services requested by the Contractor.

The notice shall be given as soon as practicable after the Employer became aware, or should have become aware, of the event or circumstances giving rise to the claim. A notice relating to any extension of the Defects Notification Period shall be given before the expiry of such period.

The particulars shall specify the Clause or other basis of the claim, and shall include substantiation of the amount and/or extension to which the Employer considers himself to be entitled in connection with the Contract. The Engineer shall then proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine (i) the amount (if any) which the Employer is entitled to be paid by the Contractor, and/or (ii) the extension (if any) of the Defects Notification Period in accordance with Sub-Clause 11.3 [Extension of Defects Notification Period].

This amount may be included as a deduction in the Contract Price and Payment Certificates. The Employer shall only be entitled to set off against or make any deduction from an amount certified in a Payment Certificate, or to otherwise claim against the Contractor, in accordance with this Sub-Clause.

3. The Engineer

3.1 Engineer's Duties and Authority

The Employer shall appoint the Engineer who shall carry out the duties assigned to him in the Contract. The Engineer's staff shall include suitably qualified engineers and other professionals who are competent to carry out these duties.

The Engineer shall have no authority to amend the Contract.

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 specific approval of the Employer before taking action under the-following Sub-Clauses of these Conditions:

(a) Sub-Clause 4.12-Unforeseeable Physical Conditions: Agreeing o determining an extension of time and/or additional cost.

(b) Sub-Clause 8.4-Extension of Time for Completion: Agreeing or determining extension of time.

(c) Sub-Clause 11.9-Performance Certificate: Issue of Performance Certificate.

(d) Sub-Clause 13.1-Instructing a Variation: Except,

i) in an emergency situation as determined by the Engineer and as amplified in sub-paras (h) and (i) below, or

ii) for other situations, if the variation in quantity of any item does not exceed 25% of the stipulated quantity in the agreement, the variation in quantity in such item does not result in increase in excess of 0.1% of contract price and variation in quantity in such item does not result in cumulative variation in contract price in excess of 2%.

(e) Sub-Clause 13.3-Variation Procedure: Approving a proposal for Variation submitted by the Contractor in accordance with Sub Clause 13.1 or 13.2.

(f) Sub-Clause 13.4-Payment in applicable Currencies: Specifying the amount payable in each of the applicable currencies for a Variation.

(g) Clause 20.1: Contractor Claims for extension of time and/or additional payment.

(h) Notwithstanding the obligation, as set out above, to obtain approval, if, in the opinion of the Engineer, an emergency occurs affecting the safety of life or of the Works or of adjoining property, he may, without relieving the Contractor of any of his duties and responsibility 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 risk. The Contractor shall forthwith comply, despite the absence of approval of the Employer, with any such instruction of the Engineer. The Engineer shall determine an addition to the Contract Price, in respect of such instruction, in accordance with Clause 13 and shall notify the Contractor accordingly, with a copy to the Employer.

(i) In case the emergency mentioned in above Sub-paras occurs on account of failure of Contractor, by way of not adhering to the approved scheme of work or not taking adequate safety precautions or by any other reason attributable to the contractor, then no additional amounts shall be paid to the Contractor for attending to such emergencies and the Contractor shall be liable for Employer's claims.

(j) Sub-clause 4.4 regarding deployment of Sub-Contractors.

3.2 Delegation by the Engineer

The Engineer may from time to time assign duties and delegate authority to assistants, and may also revoke such assignment or delegation. These assistants may include a resident engineer, and/or independent inspectors appointed to inspect and/or test items of Plant and/or Materials. The assignment, delegation or revocation shall be in writing and shall not take effect until copies have been received by both Parties.

However, unless otherwise agreed by both Parties, the Engineer shall not delegate the authority to determine any matter in accordance with Sub-Clause 3.5 [Determinations].

Assistants shall be suitably qualified persons, who are competent to carry out these duties and exercise this authority, and who are fluent in the language for communications defined in Sub-Clause 1.4 [Law and Language].

Each assistant, to whom duties have been assigned or authority has been delegated, shall only be authorised to issue instructions to the Contractor to the extent defined by the delegation. Any approval, check, certificate, consent, examination, inspection, instruction, notice, proposal, request, test, or similar act by an assistant, in accordance with the delegation, shall have the same effect as though the act had been an act of the Engineer. However:

(a) any failure to disapprove any work, Plant or Materials shall not constitute approval, and shall therefore not prejudice the right of the Engineer to reject the work, Plant or Materials;

(b) if the Contractor questions any determination or instruction of an assistant, the Contractor may refer the matter to the Engineer, who shall promptly confirm, reverse or vary the determination or instruction.

3.3Instructions of the Engineer

The Engineer may issue to the Contractor (at any time) instructions and additional or modified Drawings which may be necessary for the execution of the Works and the remedying of any defects, all in accordance with the Contract. The Contractor shall only take instructions from the Engineer, or from an assistant to whom the appropriate authority has been delegated under this Clause. If an instruction constitutes a Variation, Clause 13 [Variations and Adjustments] shall apply.

The Contractor shall comply with the instructions given by the Engineer or delegated assistant, on any matter related to the Contract. Whenever practicable, their instructions shall be given in writing. If the Engineer or a delegated assistant,

(a) gives an oral instruction and

(b) receives a written confirmation of the instruction, from (or on behalf of) the Contractor, within two working days after giving the instruction, and

(c) does not reply by issuing a written rejection and/or instruction within two working days after receiving the confirmation,

(d) then the confirmation shall constitute the written instruction of the Engineer or delegated assistant (as the case may be).

3.4 Replacement of the Engineer

Notwithstanding Sub-Clause 3.1, if the Employer intends to replace the Engineer, the Employer shall, not less than 21 days before the intended date of

replacement, give notice to the Contractor of the name, address and relevant experience of the replacement Engineer.

3.5 Determinations Whenever these Conditions provide that the Engineer shall proceed in accordance with this Sub-Clause 3.5 to agree or determine any matter, the Engineer shall consult with each Party in an endeavour to reach agreement. If agreement is not achieved, the Engineer shall make a fair determination in accordance with the Contract, taking due regard of all relevant circumstances.

The Engineer shall give notice to both Parties of each agreement or determination, with supporting particulars. Each Party shall give effect to each agreement or determination unless and until revised under Clause 20 [Claims, Disputes and Arbitration].

4. The Contractor

4.1 Contractor's General Obligations The Contractor shall design (to the extent specified in the Contract), execute and complete the Works in accordance with the Contract and with the Engineer's instructions, and shall remedy any defects in the Works.

The Contractor shall provide the Plant and Contractor's Documents specified in the Contract, and all Contractor's Personnel, Goods, consumables and other things and services, whether of a temporary or permanent nature, required in and for this design, execution, completion and remedying of defects.

All equipment, and material, to be incorporated in or required for the Works shall be procured from approved sources as stipulated in the Contract.

The Contractor shall be responsible for the adequacy, stability and safety of all Site operations and of all methods of construction. Except to the extent specified in the Contract, the Contractor (i) shall be responsible for all Contractor's Documents, Temporary Works, and such design of each item of Plant and Materials as is required for the item to be in accordance with the Contract, and (ii) shall not otherwise be responsible for the design or specification of the Permanent Works.

The Contractor shall, whenever required by the Engineer, submit details of the arrangements and methods which the Contractor proposes to adopt for the execution of the Works. No significant alteration to these arrangements and methods shall be made without this having previously been notified to the Engineer.

On completion of the works, the contractor shall arrange to furnish to the Employer two (2) bound sets of all "As Built" drawings for every component of the Works at his own cost, all such copies being on Polyester film of quality to be approved by the Engineer or his Representative. The Taking – over Certificate of the Works, as per the provisions of Clause 10.1 herein, shall not be issued by the Engineer in the event of the Contractor's failure to furnish the aforesaid "As Built" drawings for the entire works.

If the Contract specifies that the Contractor shall design any part of the Permanent Works, then unless otherwise stated in the Special Conditions of Contract:

(a) the Contractor shall submit to the Engineer the Contractor's Documents for this part in accordance with the procedures specified in the Contract;

(b) these Contractor's Documents shall be in accordance with the Specification and Drawings, shall be written in the language for communications defined in Sub-Clause 1.4 [Law and Language], and shall

include additional information required by the Engineer to add to the Drawings for co-ordination of each Party's designs;

(c) the Contractor shall be responsible for this part and it shall, when the Works are completed, be fit for such purposes for which the part is intended as are specified in the Contract; and

(d) prior to the commencement of the Tests on Completion, the Contractor shall submit to the Engineer the "as-built" documents and operation and maintenance manuals in accordance with the Specification and in sufficient detail for the Employer to operate, maintain, dismantle, reassemble, adjust and repair this part of the Works. Such part shall not be considered to be completed for the purposes of taking-over under Sub-Clause 10.1 [Taking Over of the Works and Sections] until these documents and manuals have been submitted to the Engineer.

4.2 Performance Security

The Contractor shall obtain (at his cost) a Performance Security and an additional Performance Security, if any in terms of ITB 35.5, for proper performance of the contract, for the amount, currencies and validity period for Performance Security stated in the Contract Data. If an amount is not stated in the Contract Data, this Sub-Clause shall not apply.

The Contractor shall deliver the Performance Security and additional Performance Security, if any, to the Employer within 28 days after receiving the Letter of Acceptance, and shall send a copy to the Engineer. The Performance Security/additional Performance Security shall be issued by an entity and from within a country (or other jurisdiction) approved by the Employer, and shall be in the form as given in Section 8 (Contract Forms) or in another form specifically approved by the Employer.

The Performance Security/additional Performance Security shall be, at the Contractor's option, in any of the following forms:

(i) An unconditional Bank guarantee in the prescribed format given in Section 8 (Contract Forms)

The bank guarantee shall be from a bank having minimum net-worth of over INR 500 million from the specified banks as under:

(i) a Schedule Bank in India, or

(ii) a Foreign Bank having their operations in India, or

(iii) a Foreign Bank which does not have operations in India is required to provide a counter-guarantee by State Bank of India,

In case the contractor is a JV;" the Performance Security/additional Performance Security, if any in terms of ITB 35.5, shall be submitted by each JV Partner separately on behalf of the JV in favour of EMPLOYER in proportion of their respective percentage share specified in the JV Agreement. The additional Performance Security shall be submitted by the partner(s) responsible for execution of schedule(s) (as per JV agreement) against which additional Performance Security is required to be submitted in terms of ITB 35.5. However, Submission of Performance Guarantee Security by individual partners on behalf of the JV shall in no way dilute their Joint & Several responsibility. The Employer shall be entitled to recover the amount of Bank Guarantees individually and all the Partners jointly at its discretion."

The Contractor shall ensure that the Performance Security/additional Performance Security is valid and enforceable until the Contractor has executed and completed the Works and remedied defects, if any. If the contractor does not complete the work for any reasons whatsoever, the terms of the Performance Security/ additional Performance Security specify its expiry date, and the Contractor has not become entitled to receive the Performance Certificate by the date 28 days prior to the expiry date, the Contractor shall be bound to extend the validity of the Performance Security/additional Performance Security until the Works have been completed and any defects have been remedied.

The Guarantees shall be unconditional and irrevocable. The Employer shall return the Performance Security to the Contractor within 21 days after receiving a copy of the Performance Certificate or passing of the Final Payment Certificate whichever is later. However, on completion of specified section(s) and successful passage of defect liability period for such section(s) along with execution of any leftover works at the time of completion of such section(s), the contractor shall be entitled for release of 90% of the proportionate Performance Security calculated as specified in Contract Data subject to the condition that Engineer certifies that no recoveries are pending in the contract. In case Engineer points out amount to be recovered then the contractor shall be entitled for release of 90% of the proportionate Performance Security calculated as specified in Contract Data minus the amount to be recovered.

The Employer shall return additional Performance Security submitted in terms of ITB 35.5 as per the following;

(a) If the contractor submits an application stating that all the works against the particular schedule(s)/bill(s) for which additional Performance Security was submitted in terms of ITB 35.5 have been completed in all respect, then the Employer, on being satisfied with the claim of the contractor, shall return the full additional Performance Security against the particular schedule(s). Decision of the Employer regarding completion of works against a particular schedule/bill shall be final and binding on the contractor.

(b) If the contractor submits an application stating that majority of the works (physical progress being not less than 90%) against the particular schedule(s)/bill(s) for which additional Performance Security was submitted in terms of ITB 35.5 have been completed and execution of balance works is held up for reasons not attributable to the Contractor, then the Employer, on being satisfied with the claim of the contractor, shall return 75% of the amount of additional Performance Security against the particular schedule(s). The balance amount of additional Performance Security shall however be returned only after completion of the works against the particular schedule(s)/bill(s) for which additional Performance Security was submitted in terms of ITB 35.5, in all respects to the satisfaction of the Employer. Decision of the Employer regarding completion of works against a particular schedule/bill shall be final and binding on the contractor.

Without limitation to the provisions of the rest of this Sub-Clause, whenever the Engineer determines an addition or a reduction to the Contract Price as a result of a change in cost and/or legislation or as a result of a Variation amounting to more than 25 percent of the portion of the Contract Price payable in a specific currency, the Contractor shall at the Engineer's request promptly submit Performance Guarantee @ specified in the contract data of the increased amount over the original contract price in a specific currency. On the other hand if the value of contract price decreases by more than 25% of the original contract

price payable in a specific currency, Performance Guarantee @ specified in the contract data of the decrease in contract price from the original contract price in a specific currency shall be returned to the contractor, on his request.

Wherever the contract is terminated under Clause 15.2, the Performance Guarantee shall be encashed by the Employer:

i) taken in terms of sub clause 35.5 of ITB and not due for release on the date of issue of termination letter in terms of this clause, in case of termination of the contract as a whole; Or

ii) at the discretion of the Employer it may be encashed in part/parts proportionate to the Contract price of the bill/schedule to which the terminated part of work belongs i.e P=(A x B)÷C where

P=Proportionate Bank Guarantee Amount.

A=Contract price of the particular bill/schedule to which the terminated part of work belongs.

B=Performance Guarantee amount in terms of GCC sub clause 4.2.

C=Total Contract price.

Plus additional performance Guarantee amount, if any, taken in terms of sub clause 35.5 of ITB and not due for release on the date of issue of termination letter in terms of this clause against this particular bill/schedule to which the terminated part of the work belongs, in case of termination in part/parts.

The balance work should be got done separately, and independently by EMPLOYER without risk and cost of the original contractor. The original contractor shall be debarred from participating in the tender for executing the balance work. If the failed contractor is a JV or a partnership firm, then every member/partner of such a firm would be debarred from participating in the tender for the balance work either in his/her individual capacity or as a partner of any other JV/partnership firm.

In case the contractor fails to perform the contract or any JV partner fails to perform its obligations under the JV agreement, which is a part of this agreement, the Employer may issue notice of such default to the said JV partner or the JV (depending upon reasons of default) and declare the said JV partner or the JV as Poor Performer. The issue of such notice shall automatically debar the JV partner or JV, as the case may be, from participating in any EMPLOYER tender from the date of issue of notice of default. The relevant performance security including additional performance security, if any, in terms of sub clauses 35.5 of ITB submitted by the Contractor or submitted on behalf of JV partner to the extent not due for release at the time of contemplation of such action shall be encashed and forfeited either fully or in proportion of the percentage share of that partner in the JV agreement, as the case may be.

4.3 Contractor's Representative

The Contractor shall appoint the Contractor's Representative and shall give him all authority necessary, including financial powers, to act on the Contractor's behalf under the Contract.

Unless the Contractor's Representative is named in the Contract, the Contractor shall, prior to the Commencement Date, submit to the Engineer for consent the name and particulars of the person the Contractor proposes to appoint as Contractor's Representative. If consent is withheld or subsequently revoked, or if the appointed person fails to act as Contractor's Representative, the

Contractor shall similarly submit the name and particulars of another suitable person for such appointment.

The Contractor shall not, without the prior consent of the Engineer, revoke the appointment of the Contractor's Representative or appoint a replacement.

The whole time of the Contractor's Representative shall be given to directing the Contractor's performance of the Contract. If the Contractor's Representative is to be temporarily absent from the Site during the execution of the Works, a suitable replacement person shall be appointed, subject to the Engineer's prior consent, and the Engineer shall be notified accordingly.

The Contractor's Representative shall, on behalf of the Contractor, receive instructions under Sub-Clause 3.3 [Instructions of the Engineer].

The Contractor's Representative may delegate any powers, functions and authority to any competent person, and may at any time revoke the delegation. Any delegation or revocation shall not take effect until the Engineer has received prior notice signed by the Contractor's Representative, naming the person and specifying the powers, functions and authority being delegated or revoked.

The Contractor's Representative shall be fluent in the language for communications defined in Sub-Clause 1.4 [Law and Language]. If the Contractor's Representative's delegates are not fluent in the said language, the Contractor shall make competent interpreters available during all working hours in a number deemed sufficient by the Engineer.

The Contractor shall depute his Representative to attend all the review meetings notified by the Engineer

4.4Sub-contractors

The Contractor shall not subcontract the whole of the Works. The Contractor shall be responsible for the acts or defaults of any Subcontractor, his agents or employees, as if they were the acts or defaults of the Contractor.

Unless otherwise stated in the Special Conditions of Contract:

(a) the Contractor shall not be required to obtain consent to suppliers solely of Materials, or to a subcontract for which the Subcontractor is named in the Contract or as specifically provided in the Contract data or value of any sub-contract for Works, or the aggregate value of such sub-contracts with any Subcontractor, does not exceed 5% (five per cent) of the Contract Price provided that such works are not for the key activities in terms of clause 2.6 of section 3 (Evaluation and Qualification Criteria) which are to be executed by specialist subcontractor(s);

(b) the prior consent of the Engineer shall be obtained to other proposed Subcontractors and/or suppliers. While submitting his proposal in this regard, the Contractor shall ensure that;

(i) total value of Works requiring such consent for subcontracting shall not be more than 70% (seventy per cent) of the Contract Price;

(ii) the proposed subcontractor must have executed woks of 40% of value of the proposed subcontract through a single contract during last seven years; and

(iii) No banning/blacklisting/declaration as poor performer by EMPLOYER is in force on the proposed subcontractor (on the date of grant of consent by the Engineer);

(iv) No contract of the proposed subcontractor has been terminated by EMPLOYER during the last two years (to be reckoned from the date of grant of consent by the Engineer);

(v) the Contractor shall submit the proposal for subcontracting with the name, particulars and the relevant experience of the proposed subcontractor;

(c) the Contractor shall give the Engineer not less than 28 days' notice of the intended date of the commencement of each Subcontractor's work, and of the commencement of such work on the Site;

(d) each subcontract shall include provisions which would entitle the Employer to require the subcontract to be assigned to the Employer under Sub-Clause 4.5 [Assignment of Benefit of Subcontract] (if or when applicable) or in the event of termination under Sub-Clause 15.2 [Termination by Employer]; and

(e) On getting consent from the Engineer, the Contractor shall provide to the Engineer copy of the agreement entered with such subcontractor.

The Contractor shall ensure that the requirements imposed on the Contractor by Sub-Clause 1.12 [Confidential Details] apply equally to each Subcontractor.

Where practicable, the Contractor shall give fair and reasonable opportunity for contractors from the Country to be appointed as Subcontractors.

The Contractor shall endeavour to resolve all matters and payments amicably and speedily with the sub-contractors.

The Contractor shall indemnify and hold the Employer harmless against and from any claim of subcontractors or suppliers of the materials.

The Contractor shall release payment to the Sub-contractors/Suppliers promptly and shall endeavour to resolve all issues amicably and speedily with the Sub-contractors/Suppliers, so that the execution of work is not affected in any manner whatsoever.

In case a Sub-contractor/Supplier represents to the Engineer in writing with supporting documents, stating that he has not received payment due as per the agreement/work or purchase order for the works executed by such Sub-contractor or supplies made by such Supplier, which have been covered in previous Payment Certificates and the Engineer finds such representation having merit, the Engineer, before issuing next Payment Certificate, may forward a copy of the representation to the Contractor requesting the Contractor to supply reasonable evidence that the amount stated to be outstanding by the Sub-contractor/Supplier for the works executed or supplies made, which have been covered in previous Payment Certificates has been paid and if not, why the same is not payable. The Engineer may recommend to make payment to the Sub-contractor/Supplier unless the Contractor submits reasonable evidence to the Engineer:

(i) that the amount claimed has been paid, or

(ii) satisfying the Engineer in writing that the Contractor is entitled to withhold or that the amount is not payable.

On the recommendation of the Engineer, the Employer may (at his sole discretion) directly pay to the Sub-contractor/Supplier the amount due for and on behalf of the Contractor, part or all of such amounts previously certified (less applicable deductions) as are found due to the Sub-contractor/Supplier by the Engineer. The Employer shall adjust the amount paid directly to the Sub-contractor/Supplier from any amount due by it to the Contractor. The Contractor shall repay the amount, in case no amount is found due by the Employer to the Contractor.

That the payment by Employer, on behalf of the Contractor to its Sub-contractor/Supplier, shall not alter any terms of agreement between the Employer and the Contractor and nor the same shall result in any privity of contract between the Employer and the Sub-contractor/Supplier.

4.5 Assignment of Benefit of Subcontract

If a Subcontractor's obligations extend beyond the expiry date of the relevant Defects Notification Period and the Engineer, prior to this date, instructs the Contractor to assign the benefit of such obligations to the Employer, then the Contractor shall do so. Unless otherwise stated in the assignment, the Contractor shall have no liability to the Employer for the work carried out by the Subcontractor after the assignment takes effect.

4.6 Co-operation

The Contractor shall, as specified in the Contract or as instructed by the Engineer, allow appropriate opportunities for carrying out work to:

(a) the Employer's Personnel,

(b) any other contractors employed by the Employer, and

(c) the personnel of any legally constituted public authorities,

who may be employed in the execution on or near the Site of any work not included in the Contract.

Any such instruction shall constitute a Variation if and to the extent that it causes the Contractor to incur Unforeseeable Cost. Services for these personnel and other contractors may include the use of Contractor's Equipment, Temporary Works or access arrangements which are the responsibility of the Contractor.

If, under the Contract, the Employer is required to give to the Contractor possession of any foundation, structure, plant or means of access in accordance with Contractor's Documents, the Contractor shall submit such documents to the Engineer in the time and manner stated in the Specification.

4.7 Setting Out

The Contractor shall set out the Works in relation to original points, lines and levels ofreference specified in the Contract or notified by the Engineer. The Contractor shall be responsible for the correct positioning of all parts of the Works, and shall rectify any error in the positions, levels, dimensions or alignment of the works, notifying the Engineer within 28 days of the date of commencement

In the event of such discrepancy arising during the course of the work, for which Employer's documents are handed over after the date of commencement, the contractor shall seek clarifications within 14 days of receipt of such documents

The Employer shall be responsible for any errors in these specified or notified items of reference, but the Contractor shall use reasonable efforts to verify their accuracy before they are used.

Contractor shall promptly notify the Employer and the Engineer of any error, omission, fault, or any other defect in the design, drawing or specifications for the works, which he discovers when reviewing the Contract Documents, and in the process of execution of the Works. The contractor shall be responsible to ensure correlation in various drawings and bill of quantities, before commencement and execution of work. In case of any discrepancy the contractor shall bring it to notice of the Engineer for clarification within 28 days of the issue of Letter of Acceptance. In the event of such discrepancy arising during the course of the work, for which drawings are given after the date of issue of Letter of Acceptance, the contractor shall seek clarifications within 14 days of receipt of such drawings.

4.8 Safety Procedures

The Contractor shall follow the provisions laid down in Annexure 1 to Section 7 (Special Conditions of Contract), Chapter 1. (Safety and Security) of Section 5 (Works/Employers Requirements) and shall:

(a) comply with all applicable safety regulations,

(b) take care for the safety of all persons entitled to be on the Site,

(c) use reasonable efforts to keep the Site and Works clear of unnecessary obstruction so as to avoid danger to these persons,

(d) provide fencing, lighting, guarding and watching of the Works until completion and taking over under Clause 10 [Employer's Taking Over], and

(e) provide any Temporary Works (including roadways, footways, guards and fences) which may be necessary, because of the execution of the Works, for the use and protection of the public and of owners and occupiers of adjacent land.

4.8.1

Notwithstanding with any other provision, the Contractor shall have to pay penalty for damage to Railway cable in terms of clause C 15 of the JPO as given in para 1.2 of Chapter 1. (Safety and Security) of Section 5 (Works/Employers Requirements) and shall also indemnify the Employer against any losses, damages to property or life in terms of para 1.11 and 1.12 of the chapter 1. (Safety and Security) of Section 5 (Works/Employers Requirements).

4.9 Quality Assurance

The Contractor shall institute a quality assurance system to demonstrate compliance with the requirements of the Contract. The system shall be in accordance with the details stated in the Contract. The Engineer shall be entitled to audit any aspect of the system.

Details of all procedures and compliance documents shall be submitted to the Engineer for information before each design and execution stage is commenced. When any document of a technical nature is issued to the Engineer, evidence of the prior approval by the Contractor himself shall be apparent on the document itself.

Compliance with the quality assurance system shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

4.10 Site Data

The Employer shall have made available to the Contractor for his information, prior to the Base Date, all relevant data in the Employer's possession on sub-

surface and hydrological conditions at the Site, including environmental aspects. The Employer shall similarly make available to the Contractor all such data which come into the Employer's possession after the Base Date. The Contractor shall be responsible for interpreting all such data.

To the extent which was practicable (taking account of cost and time), the Contractor shall be deemed to have obtained all necessary information as to risks, contingencies and other circumstances which may influence or affect the Bid or Works. To the same extent, the Contractor shall be deemed to have inspected and examined the Site, its surroundings, the above data and other available information, and to have been satisfied before submitting the Bid as to all relevant matters, including (without limitation):

(a) the form and nature of the Site, including sub-surface conditions,

(b) the hydrological and climatic conditions,

(c) the extent and nature of the work and Goods necessary for the execution and completion of the Works and the remedying of any defects,

(d) the Laws, procedures and labour practices of the Country, and

(e) the Contractor's requirements for access, accommodation, facilities, personnel, power, transport, water and other services.

(f) Data made available by the Employer in accordance with the preceding paragraph shall be deemed to include data listed elsewhere in the contract as open for inspection at the address stipulated in the Contract.

4.11 Sufficiency of the Accepted Contract Amount

The Contractor shall be deemed to:

(a) have satisfied himself as to the correctness and sufficiency of the Accepted Contract Amount, and

(b) have based the Accepted Contract Amount on the data, interpretations, necessary information, inspections, examinations and satisfaction as to all relevant matters referred to in Sub-Clause 4.10 [Site Data].

Unless otherwise stated in the Contract, the Accepted Contract Amount covers all the Contractor's obligations under the Contract (including those under Provisional Sums, if any) and all things necessary for the proper execution and completion of the Works and the remedying of any defects.

4.12 Unforeseeable Physical Conditions

In this Sub-Clause, "physical conditions" means natural physical conditions and man-made and other physical obstructions and pollutants, which the Contractor encounters at the Site when executing the Works, including sub-surface and hydrological conditions but excluding climatic conditions.

If the Contractor encounters adverse physical conditions which he considers to have been Unforeseeable, the Contractor shall give notice to the Engineer as soon as practicable.

This notice shall describe the physical conditions, so that they can be inspected by the Engineer, and shall set out the reasons why the Contractor considers them to be Unforeseeable. The Contractor shall continue executing the Works, using such proper and reasonable measures as are appropriate for the physical conditions, and shall comply with any instructions which the Engineer may give. If an instruction constitutes a Variation, Clause 13 [Variations and Adjustments] shall apply.

If and to the extent that the Contractor encounters physical conditions which are Unforeseeable, gives such a notice, and suffers delay and/or incurs Cost due to

these conditions, the Contractor shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price.

After receiving such notice and inspecting and/or investigating these physical conditions, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine (i) whether and (if so) to what extent these physical conditions were Unforeseeable, and (ii) the matters described in sub-paragraphs (a) and (b) above related to this extent.

However, before additional Cost is finally agreed or determined under sub-paragraph (ii), the Engineer may also review whether other physical conditions in similar parts of the Works (if any) were more favourable than could reasonably have been foreseen when the Contractor submitted the Bid. If and to the extent that these more favourable conditions were encountered, the Engineer may proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine the reductions in Cost which were due to these conditions, which may be included (as deductions) in the Contract Price and Payment Certificates. However, the net effect of all adjustments under sub-paragraph (b) and all these reductions, for all the physical conditions encountered in similar parts of the Works, shall not result in a net reduction in the Contract Price.

The Engineer may take account of any evidence of the physical conditions foreseen by the Contractor when submitting the Bid, which may be made available by the Contractor, but shall not be bound by any such evidence.

4.13 Rights of Way and Facilities

The Contractor shall bear all costs and charges for special and/or temporary rights-of-way which he may require, including those for access to the Site. The Contractor shall also obtain, at his risk and cost, any additional facilities outside the Site which he may require for the purposes of the Works.

In case any operation connected with traffic necessitates diversion, obstruction or closure of any road, railway or any other right of way, the approval of the Engineer and the concerned authorities shall be obtained well in advance by the Contractor.

Provided that if it is found necessary for the Contractor to move one or more loads of heavy constructional plants and equipment, materials or Pre-constructed units or parts of units of work over roads, highways, bridges on which such oversized and overweight items that are not normally to be moved, the contractor shall obtain prior permission from the concerned authorities.

Payments for complying with the requirements, if any, for protection or strengthening of the roads, highways or bridges shall be made by the contractor and such expenses shall be deemed to be included in his quoted contract price.

4.14 Avoidance of Interference

The Contractor shall not interfere unnecessarily or improperly with:

(a) the convenience of the public, or

(b) the access to and use and occupation of all roads and footpaths, irrespective of whether they are public or in the possession of the Employer or of others or

(c) Passenger amenities at stations and station platforms.

The Contractor shall indemnify and hold the Employer harmless against and from all damages, losses and expenses (including legal fees and expenses) resulting from any such unnecessary or improper interference.

4.15 Access Route

The Contractor shall be deemed to have been satisfied as to the suitability and availability of access routes to the Site. The Contractor shall use reasonable efforts to prevent any road or bridge from being damaged by the Contractor's traffic or by the Contractor's Personnel. These efforts shall include the proper use of appropriate vehicles and routes.

Except as otherwise stated in these Conditions:

(a) the Contractor shall (as between the Parties) be responsible for any maintenance which may be required for his use of access routes;

(b) the Contractor shall provide all necessary signs or directions along access routes, and shall obtain any permission which may be required from the relevant authorities for his use of routes, signs and directions;

(c) the Employer shall not be responsible for any claims which may arise from the use or otherwise of any access route;

(d) the Employer does not guarantee the suitability or availability of particular access routes; and

(e) Costs due to non-suitability or non-availability, for the use required by the Contractor, of access routes shall be borne by the Contractor.

4.16 Transport of Goods

Unless otherwise stated in the Special Conditions of Contract:

(a) the Contractor shall give the Engineer not less than 21 days' notice of the date on which any Plant or a major item of other Goods will be delivered to the Site;

(b) the Contractor shall be responsible for packing, loading, transporting, receiving, unloading, storing and protecting all Goods and other things required for the Works; and

(c) the Contractor shall indemnify and hold the Employer harmless against and from all damages, losses and expenses (including legal fees and expenses) resulting from the transport of Goods, and shall negotiate and pay all claims arising from their transport.

4.17 Contractor's Equipment

The Contractor shall be responsible for all Contractors' Equipment. When brought on to the Site, Contractor's Equipment shall be deemed to be exclusively intended for the execution of the Works. The Contractor shall not remove from the Site any major items of Contractor's Equipment without the consent of the Engineer. However, consent shall not be required for vehicles transporting Goods or Contractor's Personnel off Site.

In the event of Contractor imports any equipment the following shall apply" :

(a) Custom Clearance: The Employer will assist the contractor, when required by furnishing letters of recommendation for obtaining expeditious clearance through customs of constructional plants, material and other things required for the works and then for re-export, if any. The following publications, may be referred to by the contractor for guidance about custom regulations etc :

(i) Import & export policy, together with amendments, if any, published by Govt. of India, Ministry of Commerce..

(j) Hand Book of Procedures, together with amendments, if any, Volume 1 and 2 published by Ministry of Commerce.

(iii) Customs Tariff, together with amendments, if any published by Central Customs.

The Contractor shall be responsible to follow the latest rules and regulations without any liability of the Employer.

(b) Re-export of contractors equipment: The contractor shall obtain all the relevant information regarding procedure for the import and subsequent re-export of his equipment and materials from the Chief Controller of Imports and Exports, New Delhi, and shall inform himself and keep himself informed on the details of custom charges and draw-back regulations as applicable to the items of Constructional plant. The contractor shall provide the necessary guarantee/bonds where these are required by the customs notwithstanding that import licenses may be granted in the name of Employer.

(c) Notwithstanding the provisions mentioned above, Contractor's Equipment, including essential spare parts therefore, imported by the Contractor for the sole purpose of executing the Contract shall be temporarily exempt from the payment of import duties and taxes upon initial importation, provided the Contractor shall post with the customs authorities at the port of entry an approved export bond or bank guarantee, valid until the Time for Completion plus six months, in an amount equal to the full import duties and taxes which would be payable on the assessed imported value of such Contractor's Equipment and spare parts, and **callable** in the event the Contractor's Equipment is not exported from the Country on completion of the Contract. A copy of the **bond** or bank guarantee endorsed by the custom authorities shall be provided by the Contractor to the Employer upon the importation of individual items of Contractor's Equipment and spare parts. Upon export of individual items of Contractor's Equipment or spare parts, or upon the completion of the Contract, Contractor shall prepare for approval by the customs authority the authorities, an assessment of the residual value of the Contractor's Equipment and spare parts to be exported based on the depreciation scale(s) and other criteria used by the customs authorities for such purposes under the provisions of the applicable Laws. Import duties and taxes shall be due and payable to the customs authorities by the Contractor on (a) the difference between the initial imported value and the residual value of the contractor's equipment and spare parts to be exported and (b) on the initial imported value that contractor's equipments and spare parts remaining in the Country after completion of the Contract. Upon payment of such dues within 28 days of being invoiced, the bond or bank guarantee shall be reduced or released accordingly; otherwise the security shall be called in the full amount remaining in the Country.

(d) Conditions of hire of the contractor's equipment: A certified copy of the agreement in respect of any item of Equipment held by contractor under any agreement for hire or hire purchase thereof, shall be supplied to the Engineer/Employer."

4.18 Protection of the Environment

The Contractor shall take all reasonable steps to protect the environment (both on and off the Site) and to limit damage and nuisance to people and property resulting from pollution, noise and other results of his operations.

The Contractor shall ensure that emissions, surface discharges and effluent from the Contractor's activities shall not exceed the values stated in the Specification or prescribed by applicable Laws.

4.19 Electricity, Water and Gas

The Contractor shall, except as stated below, be responsible for the provision of all power, water and other services he may require.

The Contractor shall be entitled to use for the purposes of the Works such supplies of electricity, water, gas and other services as may be available on the Site and of which details and prices are given in the Specification. The Contractor shall, at his risk and cost, provide any apparatus necessary for his use of these services and for measuring the quantities consumed.

The quantities consumed and the amounts due (at these prices) for such services shall be agreed or determined by the Engineer in accordance with Sub-Clause 2.5 [Employer's Claims] and Sub-Clause 3.5 [Determinations]. The Contractor shall pay these amounts to the Employer.

4.20 Employer's Equipment and Free-Issue Material

The Employer shall make the Employer's Equipment (if any) available for the use of theContractor in the execution of the Works in accordance with the details, arrangements and prices stated in the Specification. Unless otherwise stated in the Specification:

(a) the Employer shall be responsible for the Employer's Equipment, except that

(b) the Contractor shall be responsible for each item of Employer's Equipment whilst any of the Contractor's Personnel is operating it, driving it, directing it or in possession or control of it.

The appropriate quantities and the amounts due (at such stated prices) for the use of Employer's Equipment shall be agreed or determined by the Engineer in accordance with Sub-Clause 2.5 [Employer's Claims] and Sub-Clause 3.5 [Determinations]. The Contractor shall pay these amounts to the Employer.

The Employer shall supply, free of charge, the "free-issue materials" (if any) in accordance with the details stated in the Contract data. The Employer shall, at his risk and cost, provide these materials at the time and place specified in the Contract. The Contractor shall then visually inspect them, and shall promptly give notice to the Engineer of any shortage, defect or default in these materials. Unless otherwise agreed by both Parties, the Employer shall immediately rectify the notified shortage, defect or default.

In case materials are handed over, in accordance with the procedure prescribed by the Engineer, after proper measurement and accounted for, the contractor shall be solely liable for any shortage, damage, defect or default in such material, and shall indemnify the Employer until the final accountal of materials is made by the Contractor on completion of the work.

4.21 Progress Reports

Unless otherwise stated in the Special Conditions of Contract, monthly progress reports shall be prepared by the Contractor and submitted to the Engineer in six copies. The first report shall cover the period up to the end of the first calendar month following the Commencement Date. Reports shall be submitted monthly thereafter, each within 7 days after the last day of the period to which it relates.

Reporting shall continue until the Contractor has completed all work which is known to be outstanding at the completion date stated in the Taking-Over Certificate for the Works.

Each report shall include:

- charts and detailed descriptions of progress, including each stage of design (if any), Contractor's Documents, procurement, manufacture, delivery to Site, construction, erection and testing; and including these stages for work by each nominated Subcontractor (as defined in Clause 5 [Nominated Subcontractors]),
- photographs showing the status of manufacture and of progress on the Site;
- for the manufacture of each main item of Plant and Materials, the name of the manufacturer, manufacture location, percentage progress, and the actual or expected dates of:
  - (i) commencement of manufacture,
  - (ii) Contractor's inspections,
  - (iii) tests, and

(iv) shipment and arrival at the Site;

- the details described in Sub-Clause 6.10 [Records of Contractor's Personnel and Equipment];
- copies of quality assurance documents, test results and certificates of Materials;
- list of notices given under Sub-Clause 2.5 [Employer's Claims] and notices given under Sub-Clause 20.1 [Contractor's Claims];
- safety statistics, including details of any hazardous incidents and activities relating to environmental aspects and public relations; and
- comparisons of actual and planned progress of all activities, with details of any events or circumstances which may jeopardise the completion in accordance with the Contract, and the measures being (or to be) adopted to overcome delays.

Unless otherwise stated in the Special Conditions of Contract:

4.22 Security of the Site

(a) the Contractor shall be responsible for keeping unauthorised persons off the Site, and

(b) authorised persons shall be limited to the Contractor's Personnel and the Employer's Personnel; and to any other personnel notified to the Contractor, by the Employer or the Engineer, as authorised personnel of the Employer's other contractors on the Site.

4.23 Contractor's Operations on Site

The Contractor shall confine his operations to the Site, and to any additional areaswhich may be obtained by the Contractor and agreed by the Engineer as working areas. The Contractor shall take all necessary precautions to keep Contractor's Equipment and Contractor's Personnel within the Site and these additional areas, and to keep them off adjacent land.

During the execution of the Works, the Contractor shall keep the Site free from all unnecessary obstruction, and shall store or dispose of any Contractor's Equipment or surplus materials. The Contractor shall clear away and remove from the Site any wreckage, rubbish and Temporary Works which are no longer required.

Upon the issue of a Taking-Over Certificate, the Contractor shall clear away and remove, from that part of the Site and Works to which the Taking-Over Certificate refers, all Contractor's Equipment, surplus material, wreckage, rubbish and Temporary Works. The Contractor shall leave that part of the Site and the Works in a clean and safe condition. However, the Contractor may retain on Site, during the Defects Notification Period, such Goods as are required for the Contractor to fulfill obligations under the Contract.

4.24 Fossils

All fossils, coins, articles of value or antiquity, and structures and other remains or items of geological or archaeological interest found on the Site shall be placed under the care and authority of the Employer. The Contractor shall take reasonable precautions to prevent Contractor's Personnel or other persons from removing or damaging any of these findings.

The Contractor shall, upon discovery of any such finding, promptly give notice to the Engineer, who shall issue instructions for dealing with it. If the Contractor suffers delay and/or incurs Cost from complying with the instructions, the

Contractor shall give a further notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price.

After receiving this further notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

5. Nominated Subcontractors

5.1 Definition of nominated Subcontractor

In the Contract, "nominated Subcontractor" means a Subcontractor:

(a) who is stated in the Contract as being a nominated Subcontractor, or

(b) whom the Engineer, under Clause 13 [Variations and Adjustments], instructs the Contractor to employ as a Subcontractor.

5.2 Objection to Nomination

The Contractor shall not be under any obligation to employ a nominated Subcontractor against whom the Contractor raises reasonable objection by notice to the Engineer as soon as practicable, with supporting particulars. An objection shall be deemed reasonable if it arises from (among other things) any of the following matters, unless the Employer agrees to indemnify the Contractor against and from the consequences of the matter:

(a) there are reasons to believe that the Subcontractor does not have sufficient competence, resources or financial strength;

(b) the subcontract does not specify that the nominated Subcontractor shall indemnify the Contractor against and from any negligence or misuse of Goods by the nominated Subcontractor, his agents and employees; or

(c) the subcontract does not specify that, for the subcontracted work (including design, if any), the nominated Subcontractor shall:

(i) undertake to the Contractor such obligations and liabilities as will enable the Contractor to discharge his obligations and liabilities under the Contract, and

(ii) indemnify the Contractor against and from all obligations and liabilities arising under or in connection with the Contract and from the consequences of any failure by the Subcontractor to perform these obligations or to fulfil these liabilities.

5.3 Payments to nominated Subcontractors

The Contractor shall pay to the nominated Subcontractor the amounts which the Engineer certifies to be due in accordance with the subcontract. These amounts plus other charges shall be included in the Contract Price in accordance with sub-paragraph (b) of Sub-Clause 13.5 [Provisional Sums], except as stated in Sub-Clause 5.4 [Evidence of Payments].

5.4 Evidence of Payments

Before issuing a Payment Certificate which includes an amount payable to a nominated Subcontractor, the Engineer may request the Contractor to supply reasonable evidence that the nominated Subcontractor has received (Within 7 days of receipt of previous payment by the contractor) all amounts due in accordance with previous Payment Certificates, less applicable deductions for retention or otherwise. Unless the Contractor:

(a) submits this reasonable evidence to the Engineer, or

(b)

(i) satisfies the Engineer in writing that the Contractor is reasonably entitled to withhold or refuse to pay these amounts, and

(ii) submits to the Engineer reasonable evidence that the nominated Subcontractor has been notified of the Contractor's entitlement,

then the Employer may (at his sole discretion) pay, direct to the nominated Subcontractor, part or all of such amounts previously certified (less applicable deductions) as are due to the nominated Subcontractor and for which the Contractor has failed to submit the evidence described in sub-paragraphs (a) or (b) above. The Contractor shall then repay, to the Employer, the amount which the nominated Subcontractor was directly paid by the Employer.

6. Staff and Labour

6.1 Engagement of Staff and Labour

Except as otherwise stated in the Specification, the Contractor shall make arrangements for the engagement of all staff and labour, local or otherwise, and for their payment, housing, feeding and transport.

The Contractor is encouraged, to the extent practicable and reasonable, to employ staff and labor with appropriate qualifications and experience from sources within the Country.

6.2 Rates of Wages and Conditions of Labour

The Contractor shall pay rates of wages, and observe conditions of labour, which are not lower than those established for the trade or industry where the work is carried out. If no established rates or conditions are applicable, the Contractor shall pay rates of wages and observe conditions which are not lower than the general level of wages and conditions observed locally by employers whose trade or industry is similar to that of the Contractor.

If the Employer is obliged to provide amenities or arrange payment of wages to contract labour employed by the contractor either directly or through sub contractor under the contract on account of failures on the part the contractor to provide the amenities and / or arrange payment of wages to the contract labour as required of him under the provision of the said act / rules made there under, the Engineer/Employer shall be at liberty without prejudice to the rights of Engineer/Employer under Section 20(2) and 21(4) of the contract labour (Regulation and Abolition) Act 1970 to recover the whole or part of the expenditure so incurred on the wages so paid by the Engineer/Employer/Railway from the security deposit and/or from any sum or sums due to the contractor whether under this contract or any other contract.

The Contractor shall inform the Contractor's Personnel about 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 taxes under the Laws of the Country for the time being in force, and the Contractor shall perform such duties in regard to such deductions thereof as may be imposed on him by such Laws.

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 any Act or rules made there-under, regulation or notifications including amendment. 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 Engineer/Employer shall have the right to deduct any money due to the contractor including his amount of performance security. The Employer/Engineer 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.

The employees of the Contractor and the Sub-Contractor in no case shall be treated as the employees of the Employer at any point of time.

The Contractor shall duly comply with the provisions of the Apprentices Act 1961 (III of 1961), the rules made there under and the orders that may be issued from time to time under the said Act and the said Rules and on his failure or neglect to do so he shall be subject to all liabilities provide by the said Act and said Rules.

The Contractor and his Sub Contractors shall comply with all applicable Labour Laws, and should not employ Child Labour for construction and maintenance activities. The Contractor shall provide appropriate facilities for children in Construction Camp sites.

The Contractors shall not differentiate wages between men and women for work of equal value.

6.3 Persons in the Service of Employer

The Contractor shall not recruit, or attempt to recruit, staff and labour from amongst persons in the service of the Employer or the Engineer.

6.4 Labour Laws

The Contractor shall comply with all the relevant labour Laws applicable to the Contractor's Personnel, including Laws relating to their employment, health, safety, welfare, immigration, and emigration, and shall allow them all their legal rights. The contractor and his sub-contractors shall be responsible to ensure at his own cost, compliance to all laws, bye-laws, rules and regulations for the time being in force pertaining to the employment of local or imported labour and shall take all necessary precautions to ensure and preserve the health and safety of all staff employed directly or through sub-contractors or petty contractors on the works, which shall include all the acts listed in Appendix – 1 but not limited to the same.

The Contractor shall require his employees to obey all applicable Laws, including those concerning safety at work.

During continuance of the Contract, the Contractor and his Sub-Contractors shall abide at all times by all existing labour enactments and rules made thereunder, regulations, notifications and bye laws of the State or Central government or local authority and any other labour laws (including rules), regulations, bye laws that may be passed or notification that may be issued under any labour law in future either by the State or the Central Government or the local authority. Salient features of some of the major labour laws that are applicable to construction industry are given in Appendix 1 to these Conditions of Contract.

6.5 Working Hours

No work shall be carried out on the Site on locally recognised days of rest, or outside the normal working hours stated in the Contract Data, unless:

(a) otherwise stated in the Contract,

(b) the Engineer gives consent, or

(c) 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 advise the Engineer.

6.6 Facilities for Staff and Labour

Except as otherwise stated in the Specification, the Contractor shall provide and maintain all necessary accommodation and welfare facilities for the Contractor's Personnel. The Contractor shall also provide facilities for the Employer's Personnel as stated in the Specification.

The Contractor shall not permit any of the Contractor's Personnel to maintain any temporary or permanent living quarters within the structures forming part of the Permanent Works.

6.7 Health and Safety

The Contractor shall at all times take all reasonable precautions to maintain the health and safety of the Contractor's Personnel. In collaboration with local health authorities, the Contractor shall ensure that medical staff, first aid facilities, sick bay and a standing arrangement for ambulance service are available at a phone call at all times at the Site and at any accommodation for Contractor's and Employer's Personnel, and that suitable arrangements are made for all necessary welfare and hygiene requirements and for the prevention of epidemics.

In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with and carry out such regulations, orders and requirements as may be made by the Government or the local medical or sanitary authorities, for the purpose of dealing with and overcoming the same. The Contractor shall appoint an accident prevention officer at the Site, responsible for maintaining safety and protection against accidents. This person shall be qualified for this responsibility, and shall have the authority to issue instructions and take protective measures to prevent accidents. Throughout the execution of the Works, the Contractor shall provide whatever is required by this person to exercise this responsibility and authority.

The Contractor shall send, to the Engineer, details of any accident as soon as practicable after its occurrence.

HIV-AIDS Prevention. The Contractor shall conduct an HIV-AIDS awareness programme via an approved service provider, and shall undertake such other measures as are specified in this Contract to reduce the risk of the transfer of the HIV virus between and among the Contractor's Personnel and the local community, to promote early diagnosis and to assist affected individuals.

Epidemics

In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with and carry out such regulations, orders and requirements as may be made by the Government or the local medical or sanitary authorities, for the purpose of dealing with and overcoming the same.

Records of Safety and Health

The Contractor shall maintain such records and make such reports concerning safety, health and welfare of persons and damage to property as the Engineer may from time to time prescribe.

Submission of Returns: :

The contractor shall be responsible for timely submission of all returns and statements to the concerned authorities in full compliance of all rules, bye-laws and regulations for the time being in force.

The Contractor shall throughout the contract (including the Defects Notification Period): (i) conduct Information, Education and Consultation Communication (IEC) campaigns, at least every other month, addressed to all the Site staff and

labor (including all the Contractor's employees, all Sub-Contractors and Consultants' employees, and all truck drivers and crew making deliveries to Site for construction activities) and to the immediate local communities, concerning the risks, dangers and impact, and appropriate avoidance behavior with respect to of Sexually Transmitted Diseases (STD)—or Sexually Transmitted Infections (STI) in general and HIV/AIDS in particular; (ii) provide male or female condoms for all Site staff and labor as appropriate; and (iii) provide for STI and HIV/AIDS screening, diagnosis, counseling and referral to a dedicated national STI and HIV/AIDS program, (unless otherwise agreed) of all Site staff and labor.

The Contractor shall include in the program to be submitted for the execution of the Works under Sub-Clause 8.3 an alleviation program for Site staff and labour and their families in respect of Sexually Transmitted Infections (STI) and Sexually Transmitted Diseases (STD) including HIV/AIDS. The STI, STD and HIV/AIDS alleviation program shall indicate when, how and at what cost the Contractor plans to satisfy the requirements of this Sub-Clause and the related specification. For each component, the program shall detail the resources to be provided or utilized and any related sub-contracting proposed. The program shall also include provision of a detailed cost estimate with supporting documentation. Payment to the Contractor for preparation and implementation this program shall not exceed the Provisional Sum dedicated for this purpose.

6.8 Contractor's Superintendence

Throughout the execution of the Works, and as long thereafter as is necessary to fulfil the Contractor's obligations, the Contractor shall provide all necessary superintendence to plan, arrange, direct, manage, inspect and test the work.

Superintendence shall be given by a sufficient number of persons having adequate knowledge of the language for communications (defined in Sub-Clause 1.4 [Law and Language]) and of the operations to be carried out (including the methods and techniques required, the hazards likely to be encountered and methods of preventing accidents), for the satisfactory and safe execution of the Works.

The Contractor shall employ the key personnel named in the Schedule of Personnel as referred to in the Contract Data to carry out the functions stated in the Schedule or other personnel approved by the Engineer. The Engineer will approve any proposed replacement of key personnel only if their qualifications, abilities and relevant experience are substantially equal to or better than those of the personnel listed in the Schedule.

The Contractor shall not employ any retired government Gazetted officer, who has either not completed one year after the date of retirement, or has not obtained permission to employment with the Contractor.

6.9 Contractor's Personnel

The Contractor's Personnel shall be appropriately qualified, skilled and experienced intheir respective trades or occupations. 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 if applicable, who:

(a) persists in any misconduct or lack of care,

(b) carries out duties incompetently or negligently,

(c) fails to conform with any provisions of the Contract, or

(d) persists in any conduct which is prejudicial to safety, health, or the protection of the environment.

If the Engineer asks the Contractor to remove a person who is a member of the Contractor's staff or his work force stating the reasons, the Contractor shall ensure

that the person leaves the Site within seven (7) days and has no further connectior with the work in the Contract. The replacement person shall be appointed withir fourteen (14) days of the notification by the Engineer.

A reasonable proportion of the Contractor's Superintending Staff shall have a working knowledge of the English language or the Contractor shall have available on site at all times a sufficient number of competent interpreters to ensure the proper transmission of instructions and information. If appropriate, the Contractor shall then appoint (or cause to be appointed) a suitable replacement person.

6.10 Records of Contractor's Personnel and Equipment

The Contractor shall submit, to the Engineer, details showing the number of each class of Contractor's Personnel and of each type of Contractor's Equipment on the Site. Details shall be submitted each calendar month, in a form approved by the Engineer, until the Contractor has completed all work which is known to be outstanding at the completion date stated in the Taking-Over Certificate for the Works.

6.11 Disorderly Conduct

The Contractor shall at all times take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst the Contractor's Personnel, and to preserve peace and protection of persons and property on and near the Site.

6.12 Foreign Personnel

The Contractor may bring in to 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,without any financial liability, if requested by the Contractor, use his best endeavours 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.

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. Contractor shall also be responsible for any legal liabilities during their stay.

6.13 Supply of Foodstuffs

The Contractor shall arrange for the provision of a sufficient supply of suitable food as may be stated in the Specification at reasonable prices for the Contractor's Personnel for the purposes of or in connection with the Contract.

6.14 Supply of Water

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.

6.15 Measures against Insect and Pest Nuisance

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 their danger to health. The Contractor shall comply with all the regulations of the local health authorities, including use of appropriate insecticide.

The Contractor shall provide his staff and labour with suitable prophylactics for the prevention of malaria, and take steps to prevent the formation of stagnant pools of water. He shall comply with all the regulations of the local health

authorities in these respects and shall in particular arrange to spray thoroughly with approved insecticides all buildings erected on the site such treatment shall be carried out at least once a year or as instructed by the Engineer. The Contractor shall warn his staff and labour of the dangers of diseases like Malaria, Filaria and other contagious diseases etc. and also Scorpions, Snakes, Wild animals etc. and preventive actions required to be taken by the labour and staff.

6.16 Alcoholic Liquor or Drugs 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.

6.17 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.

6.18 Festivals and Religious Customs The Contractor shall respect the Country's recognized festivals, days of rest and religious or other customs.

6.19 Funeral Arrangements The Contractor shall be responsible, to the extent required by local regulations, for making any funeral arrangements for any of his local employees who may die while engaged upon the Works.

6.20 Prohibition of Forced or Compulsory Labour The contractor shall not employ "forced or compulsory labour" in any form. "Forced or compulsory labour" consists of all work or service, not voluntarily performed, that is extracted from an individual under threat of force or penalty.

6.21 Prohibition of Harmful Child Labour The Contractor shall not employ any child to perform any work that is economically exploitative, or is likely to be hazardous to, 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.

6.22 Employment Records of Workers 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 summarized on a monthly basis and shall be available for inspection by the Engineer during normal working hours. 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].

(i) In addition to the above, the Contractor shall register his firm/company etc. on website 'www.shramikkalyan.indianrailways.gov.in' and upload requisite details of labour and their payment in this portal. These details shall be available in public domain. The Registration/ updation on Portal shall be done as under:

(a) Contractor shall apply for onetime registration of his company/firm etc. in the Shramikkalyan portal with requisite details subsequent to issue of Letter of Acceptance. Employer/Engineer shall approve the contractor's registration in the portal within 7 days of receipt of such request.

(b) Contractor once approved by any Employer/Engineer, can create password with login ID (PAN No.) for subsequent use of portal for all LoAs issued in his favour.

(c) The contractor once registered on the portal, shall provide details of his Letter of Acceptances (LoA) / Contract Agreements on shramikkalyan portal within 15 days of issue of any LoA for approval of concerned Employer/Engineer. Employer/Engineer shall update (if required) and approve the details of LoA filled by contractor within 7 days of receipt of such request.

(d) After approval of LoA by Employer/Engineer, contractor shall fill the salient details of contract labours engaged in the contract and ensure updating of each wage payment to them on shramikkalyan portal on monthly basis.

(e) It shall be mandatory upon the contractor to ensure correct and prompt uploading of all salient details of engaged contractual labour & payments made thereof after each wage period.

(ii) While processing payment of any 'Interim Payment Certificate' or 'Final Payment Certificate' or release of 'Advances' or 'Performance Guarantee / Security deposit', contractor shall submit a certificate to the Engineer or Engineer's representatives that "I have uploaded the correct details of contract labours engaged in connection with this contract and payments made to them during the wage period in Railway's Shramikkalyan portal at 'www.shramikkalyan.indianrailways.gov.in' till ____Month, ____Year."

7. Plant, Materials and Workmanship

7.1 Manner of Execution

The Contractor shall carry out the manufacture of Plant, the production andmanufacture of Materials, and all other execution of the Works:

(a) in the manner (if any) specified in the Contract,

(b) in a proper workmanlike and careful manner, in accordance with recognised good practice, and

(c) with properly equipped facilities and non-hazardous Materials, except as otherwise specified in the Contract.

7.2 Samples

The Contractor shall submit the following samples of Materials, and relevant information, to the Engineer for consent prior to using the Materials in or for the Works:

(a) manufacturer's standard samples of Materials and samples specified in the Contract, all at the Contractor's cost, and

(b) additional samples instructed by the Engineer as a Variation.

Each sample shall be labelled as to origin and intended use in the Works.

7.3 Inspection

The Employer's Personnel shall at all reasonable times:

(a) have full access to all parts of the Site and to all places from which natural Materials are being obtained, and

(b) during production, manufacture and construction (at the Site and elsewhere), be entitled to examine, inspect, measure and test the materials and workmanship, and to check the progress of manufacture of Plant and production and manufacture of Materials.

The Contractor shall give the Employer's Personnel full opportunity to carry out these activities, including providing access, facilities, permissions and safety equipment. No such activity shall relieve the Contractor from any obligation or responsibility.

The Contractor shall give notice to the Engineer whenever any work is ready and before it is covered up, put out of sight, or packaged for storage or transport. The Engineer shall then either carry out the examination, inspection, measurement or testing without unreasonable delay, or promptly give notice to the Contractor that the Engineer does not require to do so. If the Contractor fails to give the notice, he shall, if and when required by the Engineer, uncover the work and thereafter reinstate and make good, all at the Contractor's cost.

7.4 Testing

This Sub-Clause shall apply to all tests specified in the Contract, other than the Tests after Completion (if any).

The Contractor shall provide all apparatus, assistance, documents and other information, electricity, equipment, fuel, consumables, instruments, labour, materials, and suitably qualified and experienced staff, as are necessary to carry out the specified tests efficiently. The Contractor shall agree, with the Engineer, the time and place for the specified testing of any Plant, Materials and other parts of the Works.

The Engineer may, under Clause 13 [Variations and Adjustments], vary the location or details of specified tests, or instruct the Contractor to carry out additional tests. If these varied or additional tests show that the tested Plant, Materials or workmanship is not in accordance with the Contract, the cost of carrying out this Variation shall be borne by the Contractor, notwithstanding other provisions of the Contract.

The Engineer shall give the Contractor not less than 24 hours' notice of the Engineer's intention to attend the tests. If the Engineer does not attend at the time and place agreed, the Contractor may proceed with the tests, unless otherwise instructed by the Engineer, and the tests shall then be deemed to have been made in the Engineer's presence.

If the Contractor suffers delay and/or incurs Cost from complying with these instructions or as a result of a delay for which the Employer is responsible, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost , which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

The Contractor shall promptly forward to the Engineer duly certified reports of the tests. When the specified tests have been passed, the Engineer shall endorse the Contractor's test certificate, or issue a certificate to him, to that effect. If the Engineer has not attended the tests, he shall be deemed to have accepted the readings as accurate.

7.5 Rejection

If, as a result of an examination, inspection, measurement or testing, any Plant, Materials or workmanship is found to be defective or otherwise not in accordance with the Contract, the Engineer may reject the Plant, Materials or workmanship by giving notice to the Contractor, with reasons. The Contractor shall then promptly make good the defect and ensure that the rejected item complies with the Contract.

If the Engineer requires this Plant, Materials or workmanship to be retested, the tests shall be repeated under the same terms and conditions. If the rejection and retesting cause the Employer to incur additional costs, the Contractor shall subject to Sub-Clause 2.5 [Employer's Claims] pay these costs to the Employer.

7.6 Remedial Work

Notwithstanding any previous test or certification, the Engineer may instruct the Contractor to:

(a) remove from the Site and replace any Plant or Materials which is not in accordance with the Contract,

(b) remove and re-execute any other work which is not in accordance with the Contract, and

(c) execute any work which is urgently required for the safety of the Works, whether because of an accident, unforeseeable event or otherwise.

The Contractor shall comply with the instruction within a reasonable time, which shall be the time (if any) specified in the instruction, or immediately if urgency is specified under sub-paragraph (c).

If the Contractor fails to comply with the instruction, the Employer shall be entitled to employ and pay other persons to carry out the work. Except to the extent that the Contractor would have been entitled to payment for the work, the Contractor shall subject to Sub-Clause 2.5 [Employer's Claims] pay to the Employer all costs arising from this failure.

7.7 Ownership of Plant and Materials

Each item of Plant and Materials shall, to the extent consistent with the Laws of the Country, become the property of the Employer at whichever is the earlier of the following times, free from liens and other encumbrances:

(a) when it is delivered to the Site;

(b) when the Contractor is entitled to payment of the value of the Plant and Materials under Sub-Clause 8.10 [Payment for Plant and Materials in Event of Suspension].

7.8 Royalties

Unless otherwise stated in the Specification, the Contractor shall pay all royalties, rents and other payments for:

(a) natural Materials obtained from outside the Site, and

(b) the disposal of material from demolitions and excavations and of other surplus material (whether natural or man-made), except to the extent that disposal areas within the Site are specified in the Contract.

8. Commencement, Delays and Suspension

8.1 Commencement of Works

The Engineer shall give the Contractor not less than 7 days' notice of the Commencement Date. Unless otherwise stated in the Special Conditions of Contract, the Commencement Date shall be within the number of days after the Contractor receives the Letter of Acceptance as specified in Contract Data.

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.

8.2 Time for Completion

The Contractor shall complete the whole of the Works, and each Section (if any), within the Time for Completion for the Works or Section (as the case may be), including:

(a) achieving the passing of the Tests on Completion, and

(b) completing all work which is stated in the Contract as being required for whole of the Works or Section(s) to be considered to be completed for the purposes of taking-over under Sub-Clause 10.1 [Taking Over of the Works and Sections].

(c) The date of completion for works described in this sub-clause, shall be the earliest of the following :

(i) The date CRS recommends opening of the Section(s) for public carriage of passengers to Central Government, for speeds of not less than 75% of the designed operating speeds or,

(ii) The date CRS authorises the Railway Administration for opening of Section(s), subject to sanction of the Central Government for speeds of not less than 75% of the designed operating speeds, or,

(iii) The date CRS authorizes/sanctions openingof Section(s) without inspection.

8.3 Programme

The Contractor shall submit a detailed time programme to the Engineer within 28 days after receiving the notice under Sub-Clause 8.1 *[Commencement of Works].* The program shall include the physical and Financial Progress vis-à-vis program and forecast cash flow adopting Project Management Software Primavera/Sure Track/MS Project or as mutually agreed. The program must identify the milestones, interface requirements and program reporting elements. The Contractor shall supply, free of cost one set of authorized software to the Engineer and the soft copy of structured program for the project. This shall be updated every month. The Contractor shall also submit a revised programme whenever the previous programme is inconsistent with actual progress or with the Contractor's obligations. Each programme shall include:

(a) the order in which the Contractor intends to carry out the Works, including the anticipated timing of each stage of design (if any), Contractor's Documents, procurement, manufacture of Plant, delivery to Site, construction, erection and testing,

(b) each of these stages for work by each nominated Subcontractor (as defined in Clause 5 [Nominated Subcontractors]),

(c) the sequence and timing of inspections and tests specified in the Contract, and

(d) a supporting report which includes:

(i) a general description of the methods which the Contractor intends to adopt, and of the major stages, in the execution of the Works, and

(ii) details showing the Contractor's reasonable estimate of the number of each class of Contractor's Personnel and of each type of Contractor's Equipment, required on the Site for each major stage.

Unless the Engineer, within 21 days after receiving a programme, gives notice to the Contractor stating the extent to which it does not comply with the Contract, the Contractor shall proceed in accordance with the programme, subject to his other obligations under the Contract. The Employer's Personnel shall be entitled to rely upon the programme when planning their activities.

The Contractor shall promptly give notice to the Engineer of specific probable future events or circumstances which may adversely affect the work, increase the Contract Price or delay the execution of the Works. The Engineer may require the Contractor to submit an estimate of the anticipated effect of the future event or circumstances, and/or a proposal under Sub-Clause 13.3 [Variation Procedure].

If, at any time, the Engineer gives notice to the Contractor that a programme fails (to the extent stated) to comply with the Contract or to be consistent with actual progress and the Contractor's stated intentions, the Contractor shall submit a revised programme to the Engineer within 15 days in accordance with this Sub-Clause.

8.4 Extension of Time for Completion

The Contractor shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to an extension of the Time for Completion if and to the extent that completion for the purposes of Sub-Clause 10.1 [Taking-Over of the Works and Sections] is or will be delayed by any of the following causes:

(a) a Variation (unless an adjustment to the Time for Completion has been agreed under Sub-Clause 13.3 [Variation Procedure]) or other substantial change in the quantity of an item of work included in the Contract,

(b) a cause of delay giving an entitlement to extension of time under a Sub-Clause of these Conditions,

(c) exceptionally adverse climatic conditions,

(d) Unforeseeable shortages in the availability of personnel or Goods caused by epidemic or governmental actions, or

(e) any delay, impediment or prevention caused by or attributable to the Employer, the Employer's Personnel, or the Employer's other contractors.

If the Contractor considers himself to be entitled to an extension of the Time for Completion, the Contractor shall give notice to the Engineer in accordance with Sub-Clause 20.1 [Contractor's Claims]. When determining each extension of time under Sub-Clause 20.1, the Engineer shall review previous determinations and may increase, but shall not decrease, the total extension of time.

8.5 Delays Caused by Authorities

If the following conditions apply, namely:

(a) the Contractor has diligently followed the procedures laid down by the relevant legally constituted public authorities in the Country,

(b) these authorities delay or disrupt the Contractor's work, and

(c) the delay or disruption was Unforeseeable,

then this delay or disruption will be considered as a cause of delay under sub-paragraph (b) of Sub-Clause 8.4 [Extension of Time for Completion].

8.6 Rate of Progress

If, at any time:

(a) actual progress is too slow to complete within the Time for Completion, and/or

(b) progress has fallen (or will fall) behind the current programme under Sub-Clause 8.3 [Programme],

other than as a result of a cause listed in Sub-Clause 8.4 [Extension of Time for Completion], then the Engineer may instruct the Contractor to submit, under Sub-Clause 8.3 [Programme], a revised programme and supporting report describing the revised methods which the Contractor proposes to adopt in order to expedite progress and complete within the Time for Completion.

Unless the Engineer notifies otherwise, the Contractor shall adopt these revised methods, which may require increases in the working hours and/or in the numbers of Contractor's Personnel and/or Goods, at the risk and cost of the Contractor. If these revised methods cause the Employer to incur additional costs, the Contractor shall subject to Sub-Clause 2.5 [Employer's Claims] pay these costs to the Employer, in addition to delay damages (if any) under Sub-Clause 8.7 below.

8.7 Extension of Time for Completion with Delay Damages

If the Contractor fails to comply with Sub-Clause 8.2 [Time for Completion for entire work or for specified section wise completion period], and he is not entitled to an extension of time under sub clause 8.4 then the employer may grant extension of time with delay damage in such case, the Contractor shall subject to Sub-Clause 2.5 [Employer's 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 paid for every day which shall elapse between the relevant Time for Completion and the date stated in the Taking-Over Certificate.

a. In case delay is fully attributable to the contractor, then the employer may grant extension of time with delay damage as stated in the Contract Data. The decision of Employer in this regard will be final and binding.

b. In case delay is partly attributable to the contractor, then the employer may grant extension of time without or with delay damages as stated in the Contract Data, keeping in view the delays attributable to the contractor, delays for other reasons and in overall interest of completion of the work. The decision of Employer in this regard will be final and binding.

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 by Employer] 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.

The total amount due under this Sub- Clause shall not exceed the maximum amount of delay damages (if any) stated in the Contract Data.

The imposition of delay damages under this sub clause shall debar the contractor from raising any claims for extended stay.

8.7.1 Provisional Delay Damages for failure to achieve agreed target for the Financial Year :

Targets in terms of physical milestones (completion and commissioning of block sections or Major Bridges etc) be achieved during the current Financial Year from the date of commencement, duly considering the site availability, drawings etc, shall be agreed between the parties. On completion of the Financial Year, targets for next Financial Year shall be agreed similarly and so on for every Financial Year. In case of non-achievement of agreed targets in the previous Financial Year, for the reasons attributed to the contractor, provisional delay damages @ 1/5000 of Contacts Price per month shall be imposed starting from

April month till the month the targets are achieved. If multiple milestones are agreed for any Financial Year and say 3 out of 5 milestones were achieved during the Financial Year, then provisional delay damages @ (2/5 of 1/5000)of Contact Price shall be deducted till the month any of the remaining milestone is achieved. On achievement of one out of the two milestones the rate of delay damages shall stand reduced to @(1/5 of 1/5000)of Contacts Price. If no milestones are agreed for any Financial Year, the stipulation of provisional delay damages shall not apply

If the contractor complete the entire works within the original completion period or extended completion period under clause 8.4 of GCC (without imposition of delay damages), the entire amount deducted for provisional delay damages shall be refunded to the contractor . In case the contractor is unable to complete the entire works within the original completion period or extended completion period under clause 8.4 of GCC resulting in delay in completion of the project under clause 8.7 of GCC (with imposition of delay damages), then the provisional delay damages deducted shall be adjusted against the delay damages to be finally imposed on the contractor.

8.8 Suspension of Work

The Engineer may at any time instruct the Contractor to suspend progress of part or all of the Works. During such suspension, the Contractor shall protect, store and secure such part or the Works against any deterioration, loss or damage.

The Engineer may also notify the cause for the suspension. If and to the extent that the cause is notified and is the responsibility of the Contractor, the following Sub-Clauses 8.9, 8.10 and 8.11 shall not apply.

8.9 Consequences of Suspension

If the Contractor suffers delay and/or incurs Cost from complying with the Engineer's instructions under Sub-Clause 8.8 [Suspension of Work] and/or from resuming the work, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

The Contractor shall not be entitled to an extension of time for, or to payment of the Cost incurred in, making good the consequences of the Contractor's faulty design, workmanship or materials, or of the Contractor's failure to protect, store or secure in accordance with Sub-Clause 8.8 [Suspension of Work].

8.10 Payment for Plant and Materials in Event of Suspension

The Contractor shall be entitled to payment of the value (as at the date of suspension)of Plant and/or Materials, if:

(a) the work on Plant or delivery of Plant and/or Materials has been suspended for more than 28 days,

(b) the Contractor has marked the Plant and/or Materials as the Employer's property in accordance with the Engineer's instructions, and

(c) Such materials or plant is received at site.

8.11 Prolonged Suspension

If the suspension under Sub-Clause 8.8 [Suspension of Work] has continued for more than 84 days, the Contractor may request the Engineer's permission to proceed. If the Engineer does not give permission within 28 days after being

requested to do so, the Contractor may, by giving notice to the Engineer, treat the suspension as an omission under Clause 13 [Variations and Adjustments] of the affected part of the Works. If the suspension affects the whole of the Works, the Contractor may give notice of termination under Sub-Clause 16.2 [Termination by Contractor].

8.12 Resumption of Work After the permission or instruction to proceed is given, the Contractor and the Engineer shall jointly examine the Works and the Plant and Materials affected by the suspension. The Contractor shall make good any deterioration or defect in or loss of the Works or Plant or Materials, which has occurred during the suspension.

8.13 Bonus for early completion: If the Contractor achieves completion of the whole of the Works or any section(s) prior to the intended Completion Date prescribed in Contract data (Extension of time pursuant to Clause 8.4 or any other clause of these conditions will not be considered), the Employer shall pay to the Contractor a sum stated in the Contract data as bonus for early completion, for every calendar month which shall elapse between the date of completion of all items of works as stipulated in the contract, including variations ordered by the Engineer and the time prescribed in Clause 8.2.

For the purpose of calculating bonus payments, the time given in the Bid for completion of the whole works or any section(s) is fixed and unless otherwise agreed, no adjustment of the time by reasons of granting an extension of time pursuant to clause 8.4 or any other clause of these conditions will be allowed. Any period falling short of completed month shall be ignored for the purpose of computing the period relevant for the payment of bonus.

9. Tests on Completion

9.1 Contractor's Obligations The Contractor shall carry out the Tests on Completion in accordance with this Clause and Sub-Clause 7.4 [Testing], after providing the documents in accordance with sub-paragraph (d) of Sub-Clause 4.1 [Contractor's General Obligations].

The Contractor shall give to the Engineer not less than 21 days' notice of the date after which the Contractor will be ready to carry out each of the Tests on Completion. Unless otherwise agreed, Tests on Completion shall be carried out within 14 days after this date, on such day or days as the Engineer shall instruct.

In considering the results of the Tests on Completion, the Engineer shall make allowances for the effect of any use of the Works by the Employer on the performance or other characteristics of the Works. As soon as the Works, or a Section, have passed any Tests on Completion, the Contractor shall submit a certified report of the results of these Tests to the Engineer.

9.2 Delayed Tests If the Tests on Completion are being unduly delayed by the Employer, Sub-Clause 7.4 [Testing] (fifth paragraph) and/or Sub-Clause 10.3 [Interference with Tests on Completion] shall be applicable.

If the Tests on Completion are being unduly delayed by the Contractor, the Engineer may by notice require the Contractor to carry out the Tests within 21 days after receiving the notice. The Contractor shall carry out the Tests on such day or days within that period as the Contractor may fix and of which he shall give notice to the Engineer.

If the Contractor fails to carry out the Tests on Completion within the period of 21 days, the Employer's Personnel may proceed with the Tests at the risk and cost of the Contractor. The Tests on Completion shall then be deemed to have been carried out in the presence of the Contractor and the results of the Tests shall be accepted as accurate.

9.3 Retesting

If the Works, or a Section, fail to pass the Tests on Completion, Sub-Clause 7.5 [Rejection] shall apply, and the Engineer or the Contractor may require the failed Tests, and Tests on Completion on any related work, to be repeated under the same terms and conditions.

9.4 Failure to Pass Tests on Completion

If the Works, or a Section, fail to pass the Tests on Completion repeated under Sub-Clause 9.3 [Retesting], the Engineer shall be entitled to:

(a) order further repetition of Tests on Completion under Sub-Clause 9.3;

(b) if the failure deprives the Employer of substantially the whole benefit of the Works or Section, reject the Works or Section (as the case may be), in which event the Employer shall have the same remedies as are provided in sub-paragraph (c) of Sub-Clause 11.4 [Failure to Remedy Defects]; or

(c) issue a Taking-Over Certificate, if the Employer so requests.

In the event of sub-paragraph (c), the Contractor shall proceed in accordance with all other obligations under the Contract, and the Contract Price shall be reduced by such amount as shall be appropriate to cover the reduced value to the Employer as a result of this failure. Unless the relevant reduction for this failure is stated (or its method of calculation is defined) in the Contract, the Employer may require the reduction to be (i) agreed by both Parties (in full satisfaction of this failure only) and paid before this Taking-Over Certificate is issued, or (ii) determined and paid under Sub-Clause 2.5 [Employer's Claims] and Sub-Clause 3.5 [Determinations].

9.5 Contractor's obligations

Notwithstanding the provisions of sub-clauses 4.1, 9.1 to 9.4 the provisions in subsequent sub-clauses shall apply for works of Permanent Way, signaling and telecommunication and railway electrification excluding General Electrical Services.

(a) The Contractor shall be responsible for the execution of temporary and/or permanent works which may require the prior sanction/approval of Commissioner of Railway Safety (CRS) in accordance with extant rules for " The Railways opening for Public Carriage of Passengers" was amended from time to time. And applicable as and when the works are undertaken. The Contractor shall initiate the process for approval at least **63** (sixty three) days prior to undertaking such works which require the approval of Commissioner of Railway Safety (CRS) and furnish draft documentation to the Engineer.

(b) The Contractor shall ensure that existing services and operations for public carriage of passengers or goods, are not affected except those, which are essentially required to be regulated for execution of works. Such items of works shall be planned and coordinated through the Engineer.

(c) Prior to the commencement of commercial operations of passenger traffic :

(i) The Contractor may have to operate locomotives, track machines and any other rolling stock for track tamping, trial runs, etc. for which track, signaling or OHE works must comply with the specifications.

(ii) The Employer may permit freight train operations to Railway after certification by the authorized person of Zonal Railway

(iii) The Contractor shall be responsible for maintaining the facilities ensuring safety of operations under (i) & (ii) above as per specifications.

10. Employer's Taking Over

10.1 Taking Over of the Works and Sections

Except as stated in Sub-Clause 9.4 [Failure to Pass Tests on Completion], the Works shall be taken over by the Employer/Railwaywhen (i) the Works have been completed in accordance with the Contract, including the matters described in Sub-Clause 8.2 [Time for Completion] and except as allowed in sub-paragraph (a) below, and (ii) a Taking-Over Certificate for the Works has been issued, or is deemed to have been issued in accordance with this Sub-Clause.

The Contractor may apply by notice to the Engineer for a Taking-Over Certificate not earlier than 14 days before the Works will, in the Contractor's opinion, be complete and ready for taking over. If the Works are divided into Sections, the Contractor may similarly apply for a Taking-Over Certificate for each Section.

In case the works are to be taken over in accordance with sub-clause 9.5, the completed works shall be taken over by the Zonal Railway with the procedure specified by the Engineer.

The Engineer shall, within 28 days after receiving the Contractor's application:

(a) issue the Taking-Over Certificate to the Contractor, stating the date on which the Works or Section were completed in accordance with the Contract, except for any minor outstanding work and defects which will not substantially affect the use of the Works or Section for their intended purpose (either until or whilst this work is completed and these defects are remedied); or

(b) reject the application, giving reasons and specifying the work required to be done by the Contractor to enable the Taking-Over Certificate to be issued. The Contractor shall then complete this work before issuing a further notice under this Sub-Clause.

If the Engineer fails either to issue the Taking-Over Certificate or to reject the Contractor's application within the period of 28 days, and if the Works or Section (as the case may be) are substantially in accordance with the Contract, the Taking-Over Certificate shall be deemed to have been issued on the last day of that period.

10.2 Taking Over of Parts of the Works

The Engineer may, at the sole discretion of the Employer, issue a Taking-OverCertificate for any part of the Permanent Works.

The Employer shall not use any part of the Works (other than as a temporary measure which is either specified in the Contract or agreed by both Parties) unless and until the Engineer has issued a Taking-Over Certificate for this part. However, if the Employer does use any part of the Works before the Taking-Over Certificate is issued:

(a) the part which is used shall be deemed to have been taken over as from the date on which it is used,

(b) the Contractor shall cease to be liable for the care of such part as from this date, when responsibility shall pass to the Employer, and

(c) if requested by the Contractor, the Engineer shall issue a Taking-Over Certificate for this part.

After the Engineer has issued a Taking-Over Certificate for a part of the Works, the Contractor shall be given the earliest opportunity to take such steps as may be necessary to carry out any outstanding Tests on Completion. The Contractor shall carry out these Tests on Completion as soon as practicable before the expiry date of the relevant Defects Notification Period.

If the Contractor incurs Cost as a result of the Employer taking over and/or using a part of the Works, other than such use as is specified in the Contract or agreed by the Contractor, the Contractor shall (i) give notice to the Engineer and (ii) be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to payment of any such Cost, which shall be included in the Contract Price. After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine this Cost and profit.

If a Taking-Over Certificate has been issued for a part of the Works (other than a Section), the delay damages thereafter for completion of the remainder of the Works shall be reduced. Similarly, the delay damages for the remainder of the Section (if any) in which this part is included shall also be reduced. For any period of delay after the date stated in this Taking-Over Certificate, the proportional reduction in these delay damages shall be calculated as the proportion which the value of the part so certified bears to the value of the Works or Section (as the case may be) as a whole. The Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these proportions. The provisions of this paragraph shall only apply to the daily rate of delay damages under Sub-Clause 8.7 [Delay Damages], and shall not affect the maximum amount of these damages.

10.3 Interference with Tests on Completion

If the Contractor is prevented, for more than 14 days, from carrying out the Tests onCompletion by a cause for which the Employer/Engineer/other Contractors of the Employer,

are responsible, the Employer shall be deemed to have taken over the Works or Section (as the case may be) on the date when the Tests on Completion would otherwise have been completed.

The Engineer shall then issue a Taking-Over Certificate accordingly, and the Contractor shall carry out the Tests on Completion as soon as practicable, before the expiry date of the Defects Notification Period. The Engineer shall require the Tests on Completion to be carried out by giving 14 days' notice and in accordance with the relevant provisions of the Contract.

If the Contractor suffers delay and/or incurs Cost as a result of this delay in carrying out the Tests on Completion, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

10.4 Surfaces Requiring Reinstatement

Except as otherwise stated in a Taking-Over Certificate, a certificate for a Section orpart of the Works shall not be deemed to certify completion of any ground or other surfaces requiring reinstatement.

11. Defects Liability

11.1 Completion of Outstanding Work and Remedying Defects

In order that the Works and Contractor's Documents, and each Section, shall be in the condition required by the Contract (fair wear and tear excepted) by the expiry date of the relevant Defects Notification Period or as soon as practicable thereafter, the Contractor shall:

(a) complete any work which is outstanding on the date stated in a Taking-Over Certificate, within such reasonable time as is instructed by the Engineer, and

(b) execute all work required to remedy defects or damage, as may be notified by (or on behalf of) the Employer on or before the expiry date of the Defects Notification Period for the Works or Section (as the case may be).

If a defect appears or damage occurs, the Contractor shall be notified accordingly, by (or on behalf of) the Employer.

11.2 Cost of Remedying Defects

All work referred to in sub-paragraph (b) of Sub-Clause 11.1 [Completion of Outstanding Work and Remedying Defects] shall be executed at the risk and cost of the Contractor, if and to the extent that the work is attributable to:

(a) any design for which the Contractor is responsible,

(b) Plant, Materials or workmanship not being in accordance with the Contract, or

(c) failure by the Contractor to comply with any other obligation.

If and to the extent that such work is attributable to any other cause, the Contractor shall be notified promptly by (or on behalf of) the Employer, and Sub-Clause 13.3 [Variation Procedure] shall apply.

11.3 Extension of Defects Notification Period

The Employer shall be entitled subject to Sub-Clause 2.5 [Employer's Claims] to an extension of the Defects Notification Period for the Works or a Section if and to the extent that the Works, Section or a major item of Plant (as the case may be, and after taking over) cannot be used for the purposes for which they are intended by reason of a defect or damage. However, a Defects Notification Period shall not be extended by more than two years.

If delivery and/or erection of Plant and/or Materials was suspended under Sub-Clause 8.8 [Suspension of Work] or Sub-Clause 16.1 [Contractor's Entitlement to Suspend Work], the Contractor's obligations under this Clause shall not apply to any defects or damage occurring more than two years after the Defects Notification Period for the Plant and/or Materials would otherwise have expired.

11.4 Failure to Remedy Defects

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 the defect or damage is to be remedied. The Contractor shall be given reasonable notice of this date.

If the Contractor fails to remedy the defect or damage by this notified date and this remedial work was to be executed at the cost of the Contractor under Sub-Clause 11.2 [Cost of Remedying Defects], the Employer may (at his option):

(a) Carry out the work himself or by others, in a reasonable manner and at the Contractor's cost, but the Contractor shall have no responsibility for this

work; and the Contractor shall subject to Sub-Clause 2.5 [Employer's Claims] pay to the Employer the costs reasonably incurred by the Employer in remedying the defect or damage;

(b) require the Engineer to agree or determine a reasonable reduction in the Contract Price in accordance with Sub-Clause 3.5 [Determinations]; or

(c) if the defect or damage deprives the Employer of substantially the whole benefit of the Works or any major part of the Works, terminate the Contract as a whole, or in respect of such major part which cannot be put to the intended use. Without prejudice to any other rights, under the Contract or otherwise, the Employer shall then be entitled to recover all sums paid for the Works or for such part (as the case may be), plus financing costs and the cost of dismantling the same, clearing the Site and returning Plant and Materials to the Contractor.

11.5 Removal of Defective Work

If the defect or damage cannot be remedied expeditiously on the Site and theEmployer gives consent, the Contractor may remove from the Site for the purposesof repair such items of Plant as are defective or damaged. This consent may require the Contractor to increase the amount of the Performance Security by the full replacement cost of these items, or to provide other appropriate security.

11.6 Further Tests

If the work of remedying of any defect or damage may affect the performance of the Works, the Engineer may require the repetition of any of the tests described in the Contract. The requirement shall be made by notice within 28 days after the defect or damage is remedied.

These tests shall be carried out in accordance with the terms applicable to the previous tests, except that they shall be carried out at the risk and cost of the Party liable, under Sub-Clause 11.2 [Cost of Remedying Defects], for the cost of the remedial work.

11.7 Right of Access

Until the Performance Certificate has been issued, the Contractor shall have such right of access to the Works as is reasonably required in order to comply with this Clause, except as may be inconsistent with the Employer's reasonable security restrictions.

11.8 Contractor to Search

The Contractor shall, if required by the Engineer, search for the cause of any defect, under the direction of the Engineer. Unless the defect is to be remedied at the cost of the Contractor under Sub-Clause 11.2 [Cost of Remedying Defects], the Cost of the search shall be agreed or determined by the Engineer in accordance with Sub-Clause 3.5 [Determinations] and shall be included in the Contract Price.

11.9 Performance Certificate

Performance of the Contractor's obligations shall not be considered to have been completed until the Employer has issued the Performance Certificate to the Contractor, stating the date on which the Contractor completed his obligations under the Contract.

The Employer shall issue the Performance Certificate within 28 days after the latest of the expiry dates of the Defects Notification Periods, or as soon thereafter as the Contractor has supplied all the Contractor's Documents and completed and tested all the Works, including remedying any defects.

Only the Performance Certificate shall be deemed to constitute acceptance of the Works.

11.10 Unfulfilled Obligations After the Performance Certificate has been issued, each Party shall remain liable for the fulfilment of any obligation which remains unperformed at that time. For the purposes of determining the nature and extent of unperformed obligations, the Contract shall be deemed to remain in force.

11.11 Clearance of Site Upon receiving the Performance Certificate, the Contractor shall remove any remaining Contractor's Equipment, surplus material, wreckage, rubbish and Temporary Works from the Site.

If all these items have not been removed within 28 days after the Employer receives a copy of the Performance Certificate, the Employer may sell or otherwise dispose of any remaining items. The Employer shall be entitled to be paid the costs incurred in connection with, or attributable to, such sale or disposal and restoring the Site.

Any balance of the moneys from the sale shall be paid to the Contractor. If these moneys are less than the Employer's costs, the Contractor shall pay the outstanding balance to the Employer.

12. Measurement and Evaluation

12.1 Works to be Measured The Works shall be measured, and valued for payment, in accordance with this Clause.

Whenever the Engineer requires any part of the Works to be measured, reasonable notice shall be given to the Contractor's Representative, who shall:

(a) promptly either attend or send another qualified representative to assist the Engineer in making the measurement, and

(b) supply any particulars requested by the Engineer.

If the Contractor fails to attend or send a representative, the measurement made by (or on behalf of) the Engineer shall be accepted as accurate.

Except as otherwise stated in the Contract, wherever any Permanent Works are to be measured from records, these shall be prepared by the Engineer. The Contractor shall, as and when requested, attend to examine and agree the records with the Engineer, and shall sign the same when agreed. If the Contractor does not attend, the records shall be accepted as accurate.

If the Contractor examines and disagrees the records, and/or does not sign them as agreed, then the Contractor shall give notice to the Engineer of the respects in which the records are asserted to be inaccurate. After receiving this notice, the Engineer shall review the records and either confirm or vary them. If the Contractor does not so give notice to the Engineer within 14 days after being requested to examine the records, they shall be accepted as accurate.

12.2 Method of Measurement Except as otherwise stated in the Contract and notwithstanding local practice:

(a) measurement shall be made of the net actual quantity of each item of the Permanent Works, and

(b) the method of measurement shall be in accordance with the Bill of Quantities or other applicable Schedules.

12.3 Evaluation Except as otherwise stated in the contract, the Engineer shall proceed in accordance with sub clause 3.5 (Determinations) to agree or determine the contract price by evaluating each item of work, applying the

measurement agreed or determined in accordance with the above sub clause 12.1 and 12.2 and the appropriate rate or price for the item.

For each item of work, the appropriate rate or price for the item shall be the rate or price specified for such item in the contract or, if there is no such item, specified for similar work.

12.3.1

However, a new rate or price shall be appropriate for an item of work if :

(a) all the following conditions are met for existing item of the contract:

(i) the measured quantity of the item is increased by more than 50% from thequantity of this item in the Bill of Quantities or the Schedule,

(ii) this item is not specified in the contract as a "fixed rate item".

OR

(b) (i) the work is instructed under clause 13[Variations and Adjustments],

(ii) no rate or price is specified in the contract for this item, and

(iii) no specified rate or price is appropriate because the item of work is not of similar character, or is not executed under similar conditions, as any item in the contract.

OR

(c) On passage of original completion period stipulated in the contract, if site in some stretches has not been handed over for execution of the work due to any of the reasons mentioned below:

(i) non acquisition of land,

(ii) non availability of forest/wild life clearances,

(iii) non removal of encroachments, delay in shifting of utilities (to be shifted by other agencies) and

(iv) non handing over of the sites by other agencies/authorities

and the contractor otherwise has been executing the works satisfactorily on other sites, as certified by the Engineer, the contractor shall be entitled for new rates for the items and quantities of work which could not be executed in the stretches still to be handed over. In case the progress is not satisfactory, the contractor shall not be entitled for new rates and the Employer shall have the option either to continue the work in these stretches through the same agency or get it executed through other means.

In case of entitlement for new rates, if the contractor is not willing to take up the work in these stretches, he will have the option to say so in writing or if no agreement is reached on new rates, the

remaining works of such stretches shall be excluded from the scope of the contract through a variation statement. In such a case the contractor shall not be entitled for any claim or compensation on this account. The employer shall get the remaining works on these stretches executed through other means.

12.3.2

(i) Each new rate or price for item(s) as described in sub paragraph 12.3.1 (a) & (c) above shall be derived from an assessment of the reasonable cost of executing the work with an additional element of 15% towards overheads and profit of the Contractor.

(ii) Each new rate or price for item(s) as described in sub paragraph 12.3.1 (b) above shall be derived from an assessment of the reasonable cost of executing the work with an additional element of 15% towards overheads and profit of the Contractor, subject to the condition that such item(s) as described in sub paragraph 12.3.1 (b) above is/are not available in the "Standard Bill of Quantities of EMPLOYER".

(iii) In case item(s) as described in sub paragraph 12.3.1 (b) above is/are available in the latest "Standard Bill of Quantities of EMPLOYER, new rate or price for such items shall be the rate as available in the latest "Standard Bill of Quantities of EMPLOYER and price variation shall be applicable from the date upto which rates have been updated in the SBOQ.

(iv) The assessment of reasonable cost of executing the work (except over heads and profit which shall be 15%) shall be arrived at based on the prevailing rates and by taking guidance from the following documents. The priority of the documents shall be in accordance with the following sequence:

a) Analysis of Unified SOR of Indian Railway;

b) Analysis issued by MORTH;

c) Analysis of Delhi Schedule of Rates issued by CPWD;

d) Market analysis.

(v) If the final rate decided by the competent authority as per EMPLOYER SOP is not acceptable to the contractor, the contractor will be bound to execute the work at the rates as decided by the competent authority of EMPLOYER but he may refer the dispute in rate for settlement as per provisions of clause 20 of General Conditions of Contract. Until such time as an appropriate rate or price is agreed or determined, the Engineer shall make the Interim payment at the rate of 90% of the rate proposed by him and accepted by the Project Director (concerned CPM/GM in charge of the project).

12.3.3

Until such time an appropriate rate or price is agreed or determined, the Engineer shall make the Interim payment at the rate of 90% of the rate proposed by him

and accepted by the Project Director (concerned CPM/GM in charge of the project).

12.4 Omissions

Whenever the omission of any work forms part (or all) of a Variation, the value of which has not been agreed, if:

(a) the Contractor will incur (or has incurred) cost which, if the work had not been omitted, would have been deemed to be covered by a sum forming part of the Accepted Contract Amount;

(b) the omission of the work will result (or has resulted) in this sum not forming part of the Contract Price; and

(c) this cost is not deemed to be included in the evaluation of any substituted work;

then the Contractor shall give notice to the Engineer accordingly, with supporting particulars. Upon receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine this cost, which shall be included in the Contract Price.

13. Variations and Adjustments

13.1 Right to Vary

Variations may be initiated by the Employer at any time prior to issuing the Taking-Over Certificate for the Works, either by an instruction or by making a request to the Contractor to submit a proposal.

The Contractor shall execute and be bound by each Variation till the price does not exceed 50% of the agreemental value as specified in letter of acceptance / original agreement. For variation beyond the above the contractor shall be bound to execute, unless the Contractor promptly gives notice to the Engineer stating (with supporting particulars) that the Contractor cannot readily obtain the Goods required for the Variation. Upon receiving this notice, the Engineer shall cancel, confirm or vary the instruction.

Each Variation may include:

(a) changes to the quantities of any item of work included in the Contract,

(b) changes to the quality and other characteristics of any item of work,

(c) changes to the levels, positions and/or dimensions of any part of the Works,

(d) omission of any work unless it is to be carried out by others,

(e) any additional work, Plant, Materials or services necessary for the Permanent Works, including any associated Tests on Completion, boreholes and other testing and exploratory work, or

(f) changes to the sequence or timing of the execution of the Works.

(g) Re-work arising out of revision in drawings / designs / methodology of execution, after actual execution of work; excluding any re-work arising from any default of the Contractor, such as non-conformity to the quality of work /prescribed standards etc.,in the performance of obligations.

The Contractor shall not make any alteration and/or modification of the Permanent Works, unless and until the Engineer instructs or approves a Variation.

13.2 Value Engineering

The Contractor may, at any time, submit to the Engineer a written proposal which (in the Contractor's opinion) will, if adopted, (i) accelerate completion, (ii) reduce

the cost to the Employer of executing, maintaining or operating the Works, (iii) improve the efficiency or value to the Employer of the completed Works, or (iv) otherwise be of benefit to the Employer.

The proposal shall be prepared at the cost of the Contractor and shall include the items listed in Sub-Clause 13.3 [Variation Procedure].

If a proposal, which is approved by the Engineer, includes a change in the design of part of the Permanent Works, then unless otherwise agreed by both Parties:

(a) the Contractor shall design this part,

(b) sub-paragraphs (a) to (d) of Sub-Clause 4.1 [Contractor's General Obligations] shall apply, and

(c) if this change results in a reduction in the contract value of this part, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine a fee, which shall be included in the Contract Price. This fee shall be half (50%) of the difference between the following amounts:

  (i) such reduction in contract value, resulting from the change, excluding adjustments under Sub-Clause 13.7 [Adjustments for Changes in Legislation] and Sub-Clause 13.8 [Adjustments for Changes in Cost],and

  (ii) the reduction (if any) in the value to the Employer of the varied works, taking account of any reductions in quality, anticipated life or operational efficiencies.

However, if amount (i) is less than amount (ii), there shall not be a fee.

13.3 Variation Procedure

If the Engineer requests a proposal, prior to instructing a Variation, the Contractor shall respond in writing as soon as practicable, either by giving reasons why he cannot comply (if this is the case) or by submitting:

(a) a description of the proposed work to be performed and a programme for its execution,

(b) the Contractor's proposal for any necessary modifications to the programme according to Sub-Clause 8.3 [Programme] and to the Time for Completion, and

(c) the evaluation of the Variation shall be as specified in Clause 12.3 Evaluation.

The Engineer shall, as soon as practicable after receiving such proposal (under Sub-Clause 13.2 [Value Engineering] or otherwise), respond with approval, disapproval or comments. The Contractor shall not delay any work whilst awaiting a response.

Each instruction to execute a Variation, with any requirements for the recording of Costs, shall be issued by the Engineer to the Contractor, who shall acknowledge receipt.

Each Variation shall be evaluated in accordance with Clause 12 [Measurement and Evaluation], unless the Engineer instructs or approves otherwise in accordance with this Clause.

13.4 Payment in Applicable Currencies

If the Contract provides for payment of the Contract Price in more than one currency, then whenever an adjustment is agreed, approved or determined as stated above, the amount payable in each of the applicable currencies shall be specified. For this purpose, reference shall be made to the actual or expected

currency proportions of the Cost of the varied work, and to the proportions of various currencies specified for payment of the Contract Price.

13.5 Provisional Sums Each Provisional Sum shall only be used, in whole or in part, in accordance with the Engineer's instructions, and the Contract Price shall be adjusted accordingly. The total sum paid to the Contractor shall include only such amounts, for the work, supplies or services to which the Provisional Sum relates, as the Engineer shall have instructed. For each Provisional Sum, the Engineer may instruct:

(a) work to be executed (including Plant, Materials or services to be supplied) by the Contractor and valued under Sub-Clause 13.3 [Variation Procedure]; and/or

(b) Plant, Materials or services to be purchased by the Contractor, from a nominated Subcontractor (as defined in Clause 5 [Nominated Subcontractors]) or otherwise; and for which these shall be included in the Contract Price:

(i) the actual amounts paid (or due to be paid) by the Contractor, and

(ii) a sum for overhead charges and profit, calculated as a percentage of these actual amounts by applying the relevant percentage rate (if any) stated in the appropriate Schedule. If there is no such rate, the percentage rate stated in the Contract Data shall be applied.

The Contractor shall, when required by the Engineer, produce quotations, invoices, vouchers and accounts or receipts in substantiation.

13.6 Day work For work of a minor or incidental nature, the Engineer may instruct that a Variation shall be executed on a daywork basis. The work shall then be valued in accordance with the Daywork Schedule included in the Contract, and the following procedure shall apply. If a Daywork Schedule is not included in the Contract, this Sub-Clause shall not apply.

Before ordering Goods for the work, the Contractor shall submit quotations to the Engineer. When applying for payment, the Contractor shall submit invoices, vouchers and accounts or receipts for any Goods.

Except for any items for which the Daywork Schedule specifies that payment is not due, the Contractor shall deliver each day to the Engineer accurate statements in duplicate which shall include the following details of the resources used in executing the previous day's work:

(a) the names, occupations and time of Contractor's Personnel,

(b) the identification, type and time of Contractor's Equipment and Temporary Works, and

(c) the quantities and types of Plant and Materials used.

One copy of each statement will, if correct, or when agreed, be signed by the Engineer and returned to the Contractor. The Contractor shall then submit priced statements of these resources to the Engineer, prior to their inclusion in the next Statement under Sub-Clause 14.3 [Application for Interim Payment Certificates].

13.7 Adjustments for Changes in Legislation

The Contract Price shall be adjusted to take account of any increase or decrease in Cost resulting from a change in the Laws of the Country (including the introduction of new Laws and the repeal or modification of existing Laws) or in the judicial or official governmental interpretation of such Laws, made after the Base Date, which affect the Contractor in the performance of obligations under the Contract.

If the Contractor suffers (or will suffer) delay and/or incurs (or will incur) additional Cost as a result of these changes in the Laws or in such interpretations, made after the Base Date, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

In case there is a decrease in cost as a result of changes of Law by Legislation after the Base Date, the Engineer shall proceed in accordance with Sub Clause 3.5 (determination) to agree or determine these matters without waiting for Contractor's / Employer's Notice.

Notwithstanding the foregoing, the Contractor shall not be entitled to such an extension of time if the same shall already have been taken into account in determining an extension 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 13.8.

13.8 Adjustment for changes in cost.

(A) PRICE ADJUSTMENT

The amounts payable to the Contractor and valued at base rates and prices pursuant to Sub-Clause 14.3 (a) hereof shall be adjusted in respect of the rise or fall in the indexed costs for labour, Contractor's Equipment and plant, materials and other inputs to the Works, by the addition or subtraction of the amounts determined by the formulae prescribed in this clause.

(B) OTHER CHANGES IN COST

To the extent that full compensation for any rise or fall in the costs to the Contractor is not covered by the provisions of this or other Clauses in the Contract, the unit rates and prices included in the Contract shall be deemed to include amounts to cover the contingency of such other rise or fall in costs.

(C): ADJUSTMENT FORMULAE

Contract price shall be adjusted for increase or decrease in rates and price of labour, materials fuels and lubricants in accordance with the following principles and procedures as per formulae given below. The amount certified in each payment certificate is adjusted by applying

respective price adjustment factor to the payment amounts due in each currency:

a. Price adjustment shall apply only for work carried out within the stipulated time or extensions granted by the Employer and shall not apply to work carried out beyond the stipulated time: price adjustment for extensions for reasons attributable to the Contractor, shall be paid in accordance with sub-clause 13.8 (H)

b. Price adjustment shall be calculated for the local and foreign components of the payment for the work done as per formulae given below; and

c. Following expressions and meanings are assigned to the work done during each month:

R = Total value of work done during the month. It would include the value of materials on which secured advance has been granted, if any during the month less the value of materials in respect of which the secured advance has been recovered, if any, during the month. This excludes the cost of work on items for which rates were fixed under variations clause (12 and 13) for which the escalation will be regulated as mutually agreed at the time of fixation of rate.

R_I = Portion of 'R' as payable in Indian Rupees

R_f = Portion of 'R' as payable in Foreign currency (at fixed exchange rates)

= R_I+R_F

(i) Adjustment for Labour Component
Price adjustment for increase or decrease in the cost due to labour shall be paid in accordance with the following formula:

$V_L = P_I / 100 \times R_I \times (L_1 - L_0) / L_0$

V_L = Increase or decrease in the cost of work during the month under consideration due to changes in labour cost.

L_0 = Consumer price index Number for industrial workers All India – published in RBI (Reserve Bank of India) Bulletin in the month on the day 28 days prior to the closing date of submission of Bids.

L_1= Consumer price index Number for industrial workers All india- Published in RBI (Reserve Bank of india) Bulletin in the month on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related.

P_I= Percentage of Labour component of the work.

(ii) Adjustment for Cement Component

Price adjustment for increase or decrease in the cost of cement procured by the contractor shall be paid in accordance with the following formula:

$V_c = P_c / 100 \times R_I \times (C_1-C_0) / C_0$

V_c = Increase or decrease in the cost of work during the month under consideration due to changes in the rates for cement.

C_0 = The index Number of Wholesale Prices in India by Groups and Sub Groups (Averages) for 'Manufacture of cement, lime and plaster'– published in RBI (Reserve Bank of India) Bulletin in the month on the day 28 days prior to the closing date of submission of Bids.

C_1 = The index Number of Wholesale Prices in India by Groups and Sub Groups (Averages) for 'Manufacture of cement, lime and plaster' – published in RBI (Reserve Bank of India) Bulletin in the month on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related.

P_c = Percentage of Cement component of the work.

(iii) **Adjustment for Steel Component**

Price adjustment for increase or decrease in the cost of Steel procured by the contractor under different schedules of BOQ shall be paid in accordance with the following formula:

Formulae-I (for all schedules of BOQ except bill/schedule-2 B & 2 C):

$V_s = P_s / 100 \times R_I \times (S_1-S_0) / S_0$

V_s = Increase or decrease in the cost of work on the date under consideration due to changes in the rates for Steel.

S_0 = The average of rate of Rebars 10mm, Angles 75x75x6mm, Mild Steel Plates 10mm and Channel 150x75mmprovided by Joint Plant Committee for City specified in Contract Data forthe fortnight on the day 28 days prior to the closing date of submission of Bids.

S_1 = The average rate of Rebars 10mm,Angles 75x75x6mm, Mild Steel Plates 10mm and Channel 150x75mmprovided by Joint Plant Committee for City specified in Contract Datafor the fortnight on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related.

P_s = Percentage of Steel component of the work.

Formulae-II (for schedule-2 B of BOQ):

$V_s = P_s / 100 \times R_I \times (S_1-S_0) / S_0$

V_s=Increase or decrease in the cost of work on the date under consideration due to changes in the rates for Steel.

S_0 = The average rate for MS Plates 10mm and 25mm, provided by the Joint Plant Committee of the City mentioned in the contract Data in the fortnight on the day 28 days prior to the closing date of submission of Bids.

S_1 =The average rate for MS Plates 10mm and 25mm, provided by the Joint Plant Committee of the City mentioned in the contract Data in the fortnight on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related.

P_s =Percentage of Steel component of the work.

Formulae-III (for bill/schedule-2 C of BOQ):

$V_s = P_s / 100 \text{ X } R_I \text{ X } (S_1-S_0) / S_0$

V_s = Increase or decrease in the cost of work on the date under consideration due to changes in the rates for Steel.

S_0 = The average rate for TMT 10mm and 25mm, provided by the Joint Plant Committee of the City mentioned in the contract Data in the fortnight on the day 28 days prior to the closing date of submission of Bids.

S_1 = The average rate for TMT 10mm and 25mm, provided by the Joint Plant Committee of the City mentioned in the contract Data in the fortnight on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related.

P_s = Percentage of Steel component of the work.

(iv) Adjustment for Plant and Machinery and Spares Component

Price adjustment for increase or decrease in the cost of Plant and Machinery spares procured by the contractor shall be paid in accordance with the following formula:

$V_p = P_p / 100 \text{ X } R_I X (P_1-P_0) / P_0$

V_p = Increase or decrease in the cost of work during the month under consideration due to changes in the rates for Plant and Machinery spares.

P_0 = The index Number of Wholesale Prices in India by Groups and Sub Groups (Averages) for 'Manufacture of machinery for mining, quarrying and construction'– published in RBI (Reserve Bank of India) Bulletin in the month on the day 28 days prior to the closing date of submission of Bids.

P_1 = The index Number of Wholesale Prices in India by Groups and Sub Groups (Averages) for 'Manufacture of machinery for mining, quarrying and construction' – published in RBI (Reserve

Bank of India) Bulletin in the month on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related.

P_p = Percentage of Plant and Machinery spares component of the work.

(v) Adjustment for Fuel and Lubricants

Price adjustment for increase or decrease in the cost of POL(fuel and lubricants) shall be paid in accordance with the following formula:

$$V_f = P_f / 100 \text{ X } R_I \text{X } (F_1 - F_0) / F_0$$

V_f = Increase or decrease in the cost of work on the date under consideration due to changes in the rates for Fuel and lubricants.

F_0 = The average of official prices of Diesel available on the official website of 'Petroleum Planning and Analysis cell' under Ministry of Petroleum and Natural Gas for Delhi, Kolkata, Mumbai &Chennai, applicable on the day 28 days prior to the closing date of submission of Bids.

F_1 = The average of official price of Diesel available on the official website of 'Petroleum Planning and Analysis cell' under Ministry of Petroleum and Natural Gas for Delhi, Kolkata, Mumbai & Chennai, applicable on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related.

P_f = Percentage of Fuel and Lubricants component of the work.

(vi) Adjustment for Other Non Ferrous Component

Price adjustment for increase or decrease in the cost of Other Non Ferrousmetalprocured by the contractor shall be paid in accordance with the following formula:

$$V_{NF} = P_{NF} / 100 \text{ X } R_I \text{ X } (NF_1 - NF_0) / NF_0$$

V_{NF} = Increase or decrease in the cost of work during the month under consideration due to changes in the rates for Other Non Ferrousmetal.

NF_0 = The index Number of Wholesale Prices in India by Groups and Sub Groups (Averages) for 'Manufacture of non-ferrous metals incl. precious metals' – published in RBI (Reserve Bank of India) Bulletin in the month on the day 28 days prior to the closing date of submission of Bids.

NF_1 = The index Number of Wholesale Prices in India by Groups and Sub Groups (Averages) for 'Manufacture of non-ferrous metals incl. precious metals' – published in RBI (Reserve Bank of India) Bulletin in the month on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related.

P_{NF} = Percentage of Other Non Ferrousmetal component of the work.

(vii) Adjustment for Other local Materials

Price adjustment for increase or decrease in the cost of local materials other than Cement and Steel, Plant Machinery &Spares, POL and Other Non Ferrous Metals procured by the contractor shall be paid in accordance with the following formula:

$V_m = P_m / 100 \times R_i \times (M_1 - M_0) / M_0$

V_m = Increase or decrease in the cost of work during the month under consideration due to changes in the rates for local material other than cement, steel, plant spares and POL.

M_0 = The index Number of Wholesale Prices in India by Groups and Sub Groups (Averages) for All-Commodities- published in RBI (Reserve Bank of India) Bulletin in the month on the day 28 days prior to the closing date of submission of Bids.

M_1 = The index Number of Wholesale Prices in India by Groups and Sub Groups (Averages) for All -Commodities published in RBI (Reserve Bank of India) Bulletin in the month on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related

Pm =Percentage of local material component (other than cement, steel, plant, spares and POL) of the work.

(viii) <u>Price Variation Clause for Contact and Catenary Wires</u>

The Price payable shall be subject to adjustment, up or down, in accordance with the following formula:

$\mathbf{P_1 = Po + (L_2 - L_1)}$

Po = Quoted ex-works price of contact/catenary wire.

L_1 = Average LME cash settlement quotation for Copper Grade A, 60 days prior to the date of opening of the tender.

L_2 = L_2 will be minimum of (i) & (ii) given below:-

(i) LME rates prevailing on 90 days prior to the date of offering for inspection of each lot.

(ii) Invoiced rate in invoice of actual imports.

Notes:

1. For prevailing LME rates, certified copy of LME rate downloaded from official LME website will be accepted as documentary evidence.
2. LME rate in L_1 & L_2 will be converted to Indian Rupees at SBI's Selling Bills rate of exchange on the date 30 days prior to the date of opening of tender and date of delivery respectively.
3. In case index/price data are not available for particular date due to any reason then the index/price data shall be calculated by drawing a graph of Ist working day before and Ist working day after that particular date. As per graphic line price data arrived at on that particular date may be taken. .

(ix) Adjustment for Fabricated and Galvanized Steel Structures:

(Item Nos. as specified in special conditions). The price adjustment of these items shall be paid as follows:

Price Variation Clause for Fabricated and Galvanized Steel Structures for Railway Electrification Works

The Price payable shall be subject to adjustment, up or down, in accordance with the following formula:

$$P = \frac{P_o}{100}\left[11 + 57\,\frac{SBLR}{SBLR_o} + 09\,\frac{Zn}{Zn_o} + 23\,\frac{W}{W_o}\right]$$

P = Price payable as adjusted in accordance with the above formula.

P_o = Price quoted

$SBLR_o$ = Price of Steel Blooms - Retail (refer notes)

This price is as applicable on the 1st working day of the month, one month prior to the deadline for submission of bids.

Zn_o = Price of electrolytic high grade zinc (refer notes).

This price is as applicable on the 1st working day of the month, one month prior to the deadline for submission of bids.

W_o = All India average consumer price index number for industrial workers, as published by the Labour Bureau,

Ministry of Labour, Government of India(Base : 2001=100) (Refer notes). This index number is as applicable on the first working day of the month, threemonths prior to the deadline for submission of bids.

(For example, if date of tendering falls in May 2014, the applicable prices of Steel Blooms - Retail ($SBLR_o$) and electrolytic high grade zinc (Zn_o) should be for the month of April 2014 and all India average consumer price index number (W_o) should be for the month of February 2014.

The above prices and indices are as published by IEEMA vide circular reference number IEEMA (PVC)/TLT/2014one month prior to the deadline for submission of bids.*)*

SBLR = Price of Steel Blooms-Retail (refer notes).

This price is as applicable on the 1st working day of the month, two months prior to the date of delivery.

Zn=Prices of electrolytic high grade zinc (refer notes).

This price is as applicable on the first working day of the month, two months prior to the date of delivery.

W = All India average consumer price index number for industrial workers, as published by the Labour Bureau, Ministry of Labour, Govt of India. (Base 2001=100) (refer notes).

This Index number is as applicable on the first working day of the month, four month prior to the date of delivery.

(For example, if date of delivery falls in December 2014, the applicable prices of steel bloom – Retail (SBLR) and Zinc (Zn) should be for the month of October 2014 and all India average consumer price index number (W) should be for the month of August 2014.

The date of delivery is the date on which transmission line towers are notified as being ready for inspection/dispatch (in the absence of such notification, the date of manufacturer's dispatch note is to be considered as the date of delivery) or the contracted delivery date (including any agreed extension thereto), whichever is earlier.)

Notes:

(a) All prices of raw materials are exclusive of GST and any other taxes, duties, levies etc

(b) All prices are as on first working day of the month.

(c) The details of prices are as under:

1) The prices of Steel Blooms are the average Retail price of Blooms of size 150mm x 150mm of all cities in Rs/MT as published by Joint Plant Committee (JPC), Kolkata.

2) The price of electrolytic high grade zinc (in Rs/MT) is ex-works price as quoted by the primary producer.

3) Cost weight age of re-rolling / conversion charges is included in labor weightage (W)

(x) Price Variation Clause for Traction Power Transformer complete with all accessories and components

The Price payable shall be subject to adjustment, up or down, in accordance with the following formula:

$$P = \frac{P_o}{100}\left[10 + 29\frac{C}{C_o} + 27\frac{ES}{ES_o} + 7\frac{IS}{IS_o} + 5\frac{IM}{IM_o} + 7\frac{TO}{TO_o} + 15\frac{W}{W_o}\right]$$

P = Price payable as adjusted in accordance with the above formula

P_o =Price quoted/Confirmed

C_o =Average LME settlement price of copper wire bars (refer notes)

This price is as applicable for the month, ONE month prior to the date of bid opening.

ES_o = Price of CRGO Electrical Steel Lamination (refer notes)

This price is as applicable on the 1st working day of the month, ONEmonth prior to the dead line for submission of bids.

IS_o = Average price of steel plates 10 mm thick (refer notes).

This price is as applicable on the 1st working day of the month,ONE month prior to the dead line for submission of bids.

IM_o=Price of Insulating Materials (refer notes).

This price is as applicable on the 1st working day of the month, one month prior to the dead line for submission of bids.

TO_o = Price of Transformer Oil (Refer notes)

This price is as applicable on the 1st working day of the month, ONE month prior to the dead line for submission of bids.

W_o = All India average Consumer price index Number for industrial workers, as published by the labour bureau, ministry of labour, Govt. of India(base 2001 =100)

This index number is as applicable on the 1st working day of the month THREE months prior to the dead line for submission of bids.

(For example, if date of bid opening falls in June 2015, applicable prices of Copper Wire Bars (C_o),Transformer Oil (TO_o), Steel Plates 10 mm thick (IS_o), CRGO Electrical Steel Laminations (ES_o) and Insulating material (IM_o) should be as on 1st May 2015 and all India average consumer price index no. (W_o) should be for the month of March 2015.

The above prices and indices are as published by IEEMA vide circular reference number IEEMA (PVC)/PWR_TRF/-/-ONE month prior to dead line for submission of bids.

C = Average LME settlement price of copper wire bars (refer notes).

This price is as applicable for the month, TWO months prior to the date of delivery.

ES = Price of CRGO Electrical Steel Lamination (refer notes).

This price is as applicable on the 1st working day for the month, TWO months prior to the date of delivery

IS = Average price of steel plates 10 mm thick (refer notes).

This price is as applicable on the 1st working day of the month, ONE month prior to the date of delivery.

IM = Price of Insulating Materials (refer notes).

This price is as applicable on the 1st working day of the month, TWO months prior to the date of delivery.

TO= Price of transformer oil (Refer notes)

This price is as applicable on the 1st working day of the month, ONE month prior to the date of delivery

W = All India average Consumer price index Number for industrial workers, as published by the labour bureau, ministry of labour, Govt. of India(base 2001 =100)

This index number is as applicable on the 1st working day of the month THREE months prior to the date of delivery.

(For example, if date of delivery in terms of clause given below falls in December 2015, applicable prices of Copper Wire Bars (C), Insulating Material (IM), CRGO Electrical Steel Lamination (ES) should be as on 1st October 2015 and Transformer Oil (TO), Plates 10 mm thick (IS)

should be 1st November 2015and All India average Consumer price index Number (W) should be for the month of September 2015.

The date of delivery is the date on which the transformer is notified as being ready for inspection/dispatch (in the absence of such notification, the date of manufacturer's dispatch note is to be considered as the date of delivery) or the contracted delivery date (including any agreed extension thereto), whichever is earlier.

Notes:

(a) All prices of raw materials are exclusive of GST and any other taxes, duties, leviesetc. Transformers manufacturers import major raw materials like copper, CRGO steel sheets and Plates etc. The landed cost of these imported raw materials includes applicable custom duty but exclusive of GST and any other taxes, duties, levies.

(b) All prices are as on first working day of the month.

(c) The details of prices are as under:

1) The LME price of Copper Wire Bars (in Rs/MT) is the LME average settlement price of Copper Wire Bars converted into Indian Rupees with applicable average exchange rate of SBI of the month. This price is the landed cost, inclusive of applicable customs duty only but exclusive of countervailing duty.

2) The price of CRGO is the price of CRGO Electrical Steel Lamination in Rs./MT suitable for transformers of ratings above 10MVA or Voltage above 33KV up to 400 KV.

3) The price of steel is the average retail price of steel plates 10 mm thick as published by Joint Plant Committee (JPC) in Rs./MT as on 1st working day of the month.

4) The price of Insulating materials (in Rs./Kg) of pre-compressed pressboards of size 10 mm thick, 3200 mm x 4100 mm is the average C&F price in free currency per MT converted into Indian Rupees with applicable exchange rates prevailing as on 1st working day of the month as quoted by primary suppliers. This price is the landed cost, inclusive of applicable customs duty only but exclusive of countervailing duty.

5) The price of Transformer Oil (in Rs./K.Ltr.) is the average price on ex-refinery basis as quoted by primary producers for supply in drums.

(xi) PRICE VARIATION CLAUSE FOR SIGNALING & TELECOM CABLE

The price payable for signaling cables is variable as per Price Variation Formula given below:

For Signaling Copper Cables:
P= Po+CuF (Cu-Cuo) + CCFcu(CC-CCo) + FeF (Fe-Feo)

For Telecom Copper Cables For Jelly Filled, 0.9 mm dia, 6 quadcable
P= Po+CuF (Cu-Cuo) + AlFcu(Al-Alo) + CCFcu (CC-Cco) + FeF (Fe-Feo)

For Aluminum Power Cables:
P= Po+AlF (Al-Alo) + CCFAl(CC-CCo) + FeF (Fe-Feo)

Where,

P= Price payable per KM as adjusted in accordance with Price variation clause.

Po= Price per KM of cable as per Purchase order.

CuF= Variation factor for Copper

Cuo= Price of copper Rod in Rs. Per MT

CCFCu= Variation factor for PVC Compound for Copper Signaling & Telecom cable

CCo= Price of PVC Compound in Rs. Per MT

AlF= Variation factor for Aluminum

Alo= Price of EC grade LME Aluminum rods (Properzi rods) in Rs. Per MT.

CCFAl = Variation factor for PVC Compound for Aluminum power cable

FeF= Variation factor for Steel

Feo= Price of Steel for Armour (Flat strip 4 mm. x 0.8mm/ Round 1.4mm dia) in Rs. Per MT

(Prices per MT for Cuo, CCo, Feo, Alo as applicable on the 1st working day of the month, one month prior to the deadline for submission of bids. The above prices and indices are as published by IEEMA vide circular reference no. IEEMA (PVC) /CABLE --/--/-- one month prior to the deadline for submission of bids.)

Cu= Price of Copper Rod in Rs. Per MT.

CC= Price of PVC Compound in Rs. Per MT.

Fe= Price of Steel for Armouring (Flat strip 4mm x 0.8 mm/ Round 1.4mm dia) in Rs. Per MT.

Al = Price of EC grade LME Aluminum rods (Properzi rods) in Rs. Per MT.

(Prices per MT for Cu, CC, Fe, Al as prevailing on 1st working day of the calendar month covering the date One month prior to the date of inspection call letter will be applicable for the calculation of updated price.The above prices and indices are as published by IEEMA vide circular reference no. IEEMA (PVC) /CABLE --/--/-- one month prior to the date of inspection.)

The value of variation factors for copper, steel and PVC Compound are different for different sizes of signaling cables. Accordingly, the PVC formula for some of the types of signaling cable is as given under:-

Underground Railway Signaling Cable unscreened and armoured copper conductor

(i) Size 30 C x 1.5 sq.mm.
P=Po+0.391(Cu-Cuo)+0.557(CC-CCo)+0.425(Fe-Feo)

For armouring, price of steel flat strip of size 4mmx0.8mm is to be taken into consideration.

(ii) Size 24C x 1.5 sq.mm
P= Po+0.313(Cu-Cuo)+ 0.481 (CC-CCo)+0.398(Fe-Feo)

For armouring, value of steel flat strip of size 4mmx0.8mm is to be taken into consideration.

(iii) Size 19C x 1.5 sq.mm
P= Po+0.248(Cu-Cuo) + 0.395(CC-CCo)+0.343(Fe-Feo)

For armouring, value of steel flat strip of size 4mmx0.8mm is to be taken into consideration.

(iv) Size 12C x 1.5 sq.mm
P=Po+0.157(Cu-Cuo) + 0.277(CC-CCu)+0.289(Fe-Feo)

For armouring, value of steel wire size 1.4mm dia is to be taken into consideration.

(v) Size 9C x 1.5 sq.mm
P= Po+0.117(Cu-Cuo)+0.241(CC-CCu)+0.383(Fe-Feo)

For armouring, value of steel wire size 1.4mm dia is to be taken into consideration.

(vi) Size 6Cx 1.5 sq.mm
P= Po+0.078(Cu-Cuo)+0.199(CC-CCu)+0.329(Fe-Feo)

For armouring, value of steel wire size 1.4mm dia is to be taken into consideration.

(vii) Size 4Cx1.5 sq.mm
P=Po+0.052(Cu-Cuo)+0.152(CC-CCo)+0.277(Fe-Feo)

For armouring, value of steel wire size 1.4mm dia is to be taken into consideration.

(viii) Size 2C x 4 sq.mm(multistrand)
P= Po+0.073(Cu-Cuo)+0.156(CC-CCo)+0.3(Fe-Feo)

For armouring, value of steel wire size 1.4mm dia is to be taken into consideration.

(ix) Size 12C x 2.5 sq.mm
P= Po+0.282 (Cu-Cuo)+0.371 (CC-CCo)+0.342 (Fe-Feo)

For armouring, value of steel flat stripof size 4mmx0.8mm is to be taken into consideration.

(x) Size 2C x 2.5 sq.mm
P= Po+0.047 (Cu-Cuo)+0.139 (CC-CCo)+0.277 (Fe-Feo)

For armouring, value of steel wire size 1.4mm dia is to be taken into consideration.

(xi) Size 2C x 25 sq.mm PVC insulated, armoured, Aluminum power cable
P= Po+0.146 (Al-Alo)+0.303 (CC-CCo)+0.306 (Fe-Feo)

For armouring, value of steel flat stripof size 4mmx0.8mm is to be taken into consideration.

(xii) For Jelly filled, 0.9mm dia, 6 quad cable
P = Po + 0.135 (Al-Alo) + 0.139 (Cu-Cuo) + 0.515 (CC-Cco) + 0.693 (Fe-Feo).

For PVC Compound Grade CW-22, is to be taken into consideration. For armouring, value of steel flat strip of size 4mm x 0.8mm is to be taken into consideration.

For the remaining varieties of signaling cables, the formula shall be the same as in use on Indian railways.

(xii) Adjustment for Foreign Currency Component

(for each of the foreign currencies in which the contract price is payable)

a. The foreign currency component of each payment which is convertible into foreign currency at fixed exchange rate shall be adjusted in accordance with the following formula:

$VF_c = 0.85 \times R_f \times (Fe_1 - Fe_0) / Fe_0$

VF_c = Increase or decrease in the cost of work payable due to changes in the cost of foreign input.

Fe_0 = the index applicable for the foreign input(plant, material, engineer's salary etc. as the case may be) on the day 28 days prior to the date of submission of Bids, as published in the country of origin.

Fe_1 = corresponding index on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related (average index in case indices are published at lesser intervals).

a. The bidder shall, in his tender, indicate the foreign input, (plant, material, engineer's salary etc.) and appropriate index, the source of which shall be a Government or Public Organization. The bidder shall also attach specimens of the publications of the last 12 months for information of the Employer. If this index is not acceptable to the Employer, then he will specify as alternative index and the source of publishing of that index.

b. If the bidder has requested payment in more than one foreign currency, R_f shall be suitably broken up and the formula applied separately to each currency component by taking into account and corresponding indices(index and currency belonging to the same country).

c. The currency of foreign exchange payment and the index shall belong to the same country.

(D) If the contractor changes the country of origin of the source of supply of any input to the works, he shall immediately notify the Engineer who shall modify the price adjustment provisions subsequent to such change to reflect the relevant cost index from the actual country of origin of the input.

(E) If the currency in which the Contract price is expressed is different from the currencies of the sources of the relevant

indices, the Engineer shall determine the correction to be applied in calculating the Price Adjustment Factor formula viii(a) in order to avoid distortions in the amount of price adjustment. Such correction shall be applied to the increment of price fluctuation in the base costs of the respective inputs and shall correspond to the ratio of the exchange rates between the respective currencies of the date of base indices and the date of current indices as defined in sub-clause viii(a).

(F) SOURCES OF INDICES

The sources of Indices for the foreign currency portion of the Contract (R_F) not stated in Sub-Clause 13.8 (C) shall be those as listed in the Contract Data, as approved by the Employer.

(G) BASE, CURRENT AND PROVISIONAL INDICES:

BASE, CURRENT AND PROVISIONAL INDICES, THE BASE COST INDICES OR PRICES SHALL BE THOSE PREVAILING ON THE DAY 28 DAYS PRIOR TO THE CLOSING DATE FOR SUBMISSION OF BIDS. CURRENT INDICES OR PRICES SHALL BE THOSE PREVAILING ON THE DAY 28 DAYS PRIOR TO LAST DAY OF THE PERIOD TO WHICH A PARTICULAR INTERIM PAYMENT CERTIFICATE IS RELATED. IF AT ANY TIME THE CURRENT INDICES ARE NOT AVAILABLE, PROVISIONAL INDICES AS DETERMINED BY THE ENGINEER WILL BE USED, SUBJECT TO SUBSEQUENT CORRECTION OF THE AMOUNTS PAID TO THE CONTRACTOR WHEN THE CURRENT INDICES BECOME AVAILABLE. THE INDEX NUMBERS OF VARIOUS GROUPS AND SUB GROUPS AS PUBLISHED BY RESERVE BANK OF INDIA IN THE RBI BULLETIN WILL BE CONSIDERED FOR THIS PURPOSE.

(H) LIMIT OF PRICE ADJUSTMENT

Provided that, in determining all such price adjustment in accordance with the aforesaid Sub-Clauses:

a. No account will be taken of any amount by which any cost incurred by the Contractor has been increased by default or negligence of the Contractor.

If the Contractor fails to complete the work within time for completion prescribed under Clause 8.2, the adjustment of prices thereafter until the completion of the works shall be made using either the indices or prices, whichever is more favourable to the Employer, provided that if an extension of time is granted pursuant to Sub-Clause 8.4, the above position shall apply to the adjustments made after expiry of such extension of time.

(I) Percentages governing adjustments for change in cost

The percentages governing the price adjustment for the local currency portion (R_i) of the contract for various works is given in **Annexure 2.**

(J) Indices to be used in case of Interim Payment Certificate for a period more than a month

As per provisions of contract (Clause 14.3 of GCC) interim payments certificates are to be submitted by the contractor on monthly basis for the works/supply of items pertaining to a particular month. In such cases the monthly indices will be applied for the month on the day 28 days prior to the last day of the period to which a particular interim payment certificate is related. However, in case a bill is submitted for a period pertaining to more than a calendar month the average indices for those months on the day 28 days prior to last day of the period to which bill pertains and previous month(s) shall be used for calculation purpose.

14. Contract Price and Payment

14.1 The Contract Price

Unless otherwise stated in the Special Conditions of Contract:

(a) the Contract Price shall be agreed or determined under Sub-Clause 12.3 [Evaluation] and be subject to adjustments in accordance with the Contract;

(b) the Contractor shall pay all taxes, duties and fees required to be paid by him under the Contract, and the Contract Price shall not be adjusted for any of these costs except as stated in Sub-Clause 13.7 [Adjustments for Changes in Legislation];

(c) any quantities which may be set out in the Bill of Quantities or other Schedule are estimated quantities and are not to be taken as the actual and final quantities:

(i) of the Works which the Contractor is required to execute, or

(ii) for the purposes of Clause 12 [Measurement and Evaluation]; and

(d) the Contractor shall submit to the Engineer, within 28 days after the Commencement Date, a proposed breakdown of each lump sum price in the Schedules, if applicable. The Engineer may take account of the breakdown when preparing Payment Certificates, but shall not be bound by it.

(e) It may be noted that in the event of the Contractor not making the due payments stated in sub-clause (b) above, and the concerned party puts up a claim with the Employer / Engineer, then the Employer / Engineer may make such payments and deduct the same from the sums due to the Contractor.

14.2 Advance Payment

14.2.1 Mobilization Advance

The Employer shall make payment, as an Interest bearing advance for mobilization, when the Contractor submits a guarantee in accordance

with this Sub-Clause. The total advance payment, the number and timing of instalments (if more than one), and the applicable currencies and proportions, shall be as stated in the Contract Data.

Unless and until the Employer receives this guarantee, or if the total advance payment is not stated in the Contract Data, this Sub-Clause shall not apply.

The Engineer shall issue an interim payment certificate for the first installment of mobilisation advance after receiving an application for advance payment(under sub clause 14.3 [Application for Interim Payment Certificates]) and after the Employer receives (i) the Performance Security in accordance with Sub-Clause 4.2 [Performance Security] and (ii) a guarantee in amounts and currencies equal to the advance payment plus 10%. The next installment shall be released only when the contractor submits statement of having utilized the previous installment of mobilization advance and the Employer is satisfied that the utilization has been done in purposeful manner.

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14.2.2 Advance against Plant and Machinery

Interest bearing advance against plant and machinery, is payable for procurement of plant, equipment and machinery to be utilized specifically for the subject works, with following stage payments:

Stage-1: At the stage of Purchase Order	50% of the total permissible advance payment or actual payment made whichever is less, provided that the contractor has submitted copy of Purchase Order and the invoices duly certified from the firm and against a guarantee in amounts and currencies equal to the stage advance payment plus 10%.
Stage-2: At the stage of dispatch of the plant and machinery from manufacturing unit/ assembly point	Cumulative 90% of the permissible advance payment or actual payment made whichever is less, against a guarantee in amounts and currencies equal to the stage advance payment plus 10%. In case of domestic manufacture, provided the contractor has submitted GST invoice and Delivery Challan (Interstate movement Challan to the worksite) and in case of foreign manufacture provided the contractor has submitted Bill of Lading (BOL), Final Inspection Certificate and Transit Insurance.
Stage-3: At the stage of arrival of plant & machinery at the work site	Remaining of the permissible advance payment, against a guarantee in amounts and currencies equal to the stage advance payment plus 10%. Provided Plant & Machinery have reached the site, physical verification by Engineer and

	submission of commissioning certificate of the Plant & Machinery.

The total advance payment under this sub-clause, including the applicable currencies and proportions, shall be as stated in the Contract Data.

All such plant, equipment and machinery shall be used only for executing the works under this Contract. No such plant, equipment and machinery shall be removed from the site, unless advance equivalent to the advance against such machinery has been fully repaid and prior permission of the Engineer has been obtained.

The Engineer shall decide whether a particular plant, equipment or machinery is actually required to execute the work. No advance is payable against items identified as unnecessary. The plant and machinery admissible for advance payment and its valuation shall be done by the Engineer on following considerations;

i. New items: 80% of purchase price.
ii. Used or Second-hand items: Not to be considered.
iii. New Items valued at less than ₹ 10,00,000 each: Not to be considered.

14.2.3 Guarantees

Advances as mentioned in sub-clauses 14.2.1 & 14.2.2 above, shall be payable against acceptable Bank Guarantees from banks as specified in clause 4.2. The guarantees shall be in the form as given in Section 8 (Contract Forms) or in another form approved by the Employer. The Contractor shall ensure that the guarantees are valid and enforceable until the advance amount paid as has been repaid, but its amount may be progressively reduced by the amount repaid by theContractor as indicated in the Payment Certificates. If the terms of the guarantee specify its expiry date, and the advance payment has not been repaid by the date 28 days prior to the expiry date, the Contractor shall extend the validity of the guarantee until the advance payment has been repaid.

14.2.4 Recovery of Advances

Unless stated otherwise in the Contract Data, the advance payment shall be repaid through percentage deductions from the interim payments determined by the Engineer in accordance with Sub-Clause 14.6 [Issue of Interim Payment Certificates], as follows:

(a) deductions shall commence in the next interim Payment Certificate following that in which the total of all certified interim payments (excluding the advance payment) exceeds 5 percent of the Accepted Contract Amount less Provisional Sums or passage of six months from the date of release of first advance payment, whichever is earlier; and

(b) deductions shall be made for accrued interest on the advance up to the month and advance at the rate stated in the Contract Data of the amount of each Interim Payment Certificate (excluding the

advance payment and deductions and repayments of retention) in the currencies and proportions of the advance payment until such time as the advance payment and accrued interest has been repaid; provided that the advance payment and accrued interest shall be completely repaid prior to the time when 80 percent of the Accepted Contract Amount has beencertified for payment. If the amount of interim payment certificate is not sufficient for recovery of accrued interest or in the opinion of the Employer satisfactory progress is not being achieved by the contractor, then the contractor will have to deposit the accrued interest and return the mobilisation advance in part or in full as demanded by the Employer, failing which Employer shall have the right to encash the Bank Guarantee(s)

The contractor shall always have the option to start repayment earlier and/or to complete the repayment earlier than the due date.

If the advance payment has not been repaid prior to the issue of the Taking-Over Certificate for the Works or prior to termination under Clause 15 [Termination by Employer], Clause 16 [Suspension and Termination by Contractor] or Clause 19 [Force Majeure] (as the case may be), the whole of the balance then outstanding shall immediately become due and payable by the Contractor to the Employer.

14.2.5 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 him. 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.

The Contractor, if required by the Engineer shall provide the details of utilisation of Mobilisation advance.

14.3 Application for Interim Payment Certificates

The Contractor shall submit a Statement in six copies to the Engineer in accordance with the payment procedure specified by the Engineer, after the end of each month, in a form approved by the Engineer, showing in detail the amounts to which the Contractor considers himself to be entitled, together with supporting documents which shall include the report on the progress during this month in accordance with Sub-Clause 4.21 [Progress Reports] and Record Measurement Sheets.

The Statement shall include the following items, as applicable, which shall be expressed in the various currencies in which the Contract Price is payable, in the sequence listed:

(a) the estimated contract value of the Works executed and the Contractor’s Documents produced up to the end of the month

(including Variations but excluding items described in sub-paragraphs (b) to (g) below);

(b) any amounts to be added and deducted for changes in legislation and changes in cost, in accordance with Sub-Clause 13.7 [Adjustments for Changes in Legislation] and Sub-Clause 13.8 [Adjustments for Changes in Cost];

(c) any amount to be deducted for retention, calculated by applying the percentage of retention stated in the Contract Data to the total of the above amounts, until the amount so retained by the Employer reaches the limit of Retention Money (if any) stated in the Contract Data;

(d) Any amounts to be added and deducted for the advance payments and repayments in accordance with sub clause 14.2 [Advance Payment];

(e) any amounts to be added and deducted for Plant and Materials in accordance with Sub-Clause 14.5 [Plant and Materials intended for the Works];

(f) any other additions or deductions which may have become due under the Contract or otherwise, including those under Clause 20 [Claims, Disputes and Arbitration]; and

(g) the deduction of amounts certified in all previous Payment Certificates.

(h) for invoicing as per GST Laws, the estimated contract value of the Works executed in terms of (a) above and any amounts added or deducted as per (b), (e) to (g) above is to be broken up in two components i.e. (i) the base amount excluding GST (ii) GST component (calculated at the rate for works contract service as per GST Laws).

(i) Statement of interim payments certificates should be submitted by the Contractor to the Engineer by the 7th day of each month for the work executed upto the end of the previous month.

(j) An amount to be deducted for the payments to be made to different Departments towards payments liable to be made by the Contractor.

14.4 Schedule of Payments

If the Contract includes a schedule of payments specifying the instalments in which the Contract Price will be paid, then unless otherwise stated in this schedule:

(a) the instalments quoted in this schedule of payments shall be the estimated contract values for the purposes of sub-paragraph (a) of Sub-Clause 14.3 [Application for Interim Payment Certificates];

(b) Sub-Clause 14.5 [Plant and Materials intended for the Works] shall not apply; and

(c) if these instalments are not defined by reference to the actual progress achieved in executing the Works, and if actual progress is found to be less than that on which this schedule of payments was based, then the Engineer may proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine revised instalments, which shall take account of the extent to which progress is less than that on which the instalments were previously based.

If the Contract does not include a schedule of payments, the Contractor shall submit non-binding estimates of the payments which he expects to become due during each quarterly period. The first estimate shall be submitted within 42 days after the Commencement Date. Revised estimates shall be submitted at quarterly intervals, until the Taking-Over Certificate has been issued for the Works.

14.5 Plant and Materials intended for the Works

If this Sub-Clause applies, Interim Payment Certificates shall include, under sub-paragraph (e) of Sub-Clause 14.3:

(i) an amount for Plant and Materials which have been sent to the Site for incorporation in the Permanent Works, and

(ii) a reduction when the contract value of such Plant and Materials is included as part of the Permanent Works under sub-paragraph (a) of Sub-Clause 14.3 [Application for Interim Payment Certificates].

If the lists referred to in sub-paragraphs (b)(i) or (c)(i) below are not included in the Contract Data, this Sub-Clause shall not apply.

The Engineer shall determine and certify each addition if the following conditions are satisfied:

(a) the Contractor has:

(i) kept satisfactory records (including the orders, receipts, Costs and use of Plant and Materials) which are available for inspection, and

(ii) submitted a statement of the Cost of acquiring and delivering the Plant and Materials to the Site, supported by satisfactory evidence;

and either:

(b) the relevant Plant and Materials:

(i) are those listed in the Schedules for payment when shipped,

(ii) have been shipped to the Country, en route to the Site, in accordance with the Contract; and

(iii) are described in a clean shipped bill of lading or other evidence of shipment, which has been submitted to the Engineer together with evidence of payment of freight and insurance, any other documents reasonably required, and a bank guarantee in a form

and issued by an entity approved by the Employer in amounts and currencies equal to the amount due under this Sub-Clause: this guarantee may be in a similar form to the form referred to in Sub-Clause 14.2 [Advance Payment] and shall be valid until the Plant and Materials are properly stored on Site and protected against loss, damage or deterioration;

or

(c) the relevant Plant and Materials:

(i) are those listed in the Schedules for payment when delivered to the Site,

(ii) the original 'Invoice' and the original 'Inspection Certificate' by the approved Inspection agency marked 'for payment' is furnished with the Application for IPC [sub-Clause 14.3].

(iii) have been delivered to and are properly stored on the Site, are protected against loss, damage or deterioration, and appear to be in accordance with the Contract.

The additional amount to be certified shall be the equivalent of eighty percent of the Engineer's determination of the cost of the Plant and Materials (including delivery to Site), taking account of the documents mentioned in this Sub-Clause and of the contract value of the Plant and Materials. The amount shall be certified on receipt of an Indemnity Bond for the stated amount in the Form approved by the Employer.

The currencies for this additional amount shall be the same as those in which payment will become due when the contract value is included under sub-paragraph (a) of Sub-Clause 14.3 [Application for Interim Payment Certificates]. At that time, the Payment Certificate shall include the applicable reduction which shall be equivalent to, and in the same currencies and proportions as, this additional amount for the relevant Plant and Materials.

14.6 Issue of Interim Payment Certificates

No amount will be certified or paid until the employer has received and approved the performance security. Thereafter, the Engineer shall within two days after receiving a statement and supporting documents (including Contractor's certificate in terms of Sub-Clause 6.22 (ii)), issue to the Employer a provisional interim payment certificate which shall state the amount which the Engineer determines to be due after preliminary check as per EMPLOYER's procedure order. After this the Engineer shall, within 28 days after receiving a statement and supporting documents, issue to the employer an Interim Payment Certificate which shall state the amount which the Engineer fairly determines to be due, with supporting particulars.

However, prior to issuing the Taking-Over Certificate for the Works, the Engineer shall not be bound to issue the Interim Payment Certificate in an amount which would (after retention and other deductions) be less than the minimum amount of Interim Payment Certificates (if any) stated in the Contract Data. In this event, the Engineer shall give notice to the Contractor accordingly.

An Interim Payment Certificate shall not be withheld for any other reason, although:

(a) if anything supplied or work done by the Contractor is not in accordance with the Contract, the cost of rectification or replacement may be withheld until rectification or replacement has been completed; and/or

(b) if the Contractor was or is failing to perform any work or obligation in accordance with the Contract, and had been so notified by the Engineer, the value of this work or obligation may be withheld until the work or obligation has been performed.

The Engineer may in any Payment Certificate make any correction or modification that should properly be made to any previous Payment Certificate. A Payment Certificate shall not be deemed to indicate the Engineer's acceptance, approval, consent or satisfaction.

14.7 Payment

The Employer shall pay to the Contractor:

(a) the first instalment of the advance payment within 42 days after issuing the Letter of Acceptance or within 21 days after receiving the documents in accordance with Sub-Clause 4.2 [Performance Security] and Sub-Clause 14.2 [Advance Payment], whichever is later;

(b) (i) After preliminary scrutiny and certifications by the Engineer, payment of 70% of the certified net payment due (after recoveries and deductions), shall be made by the Employer within 10 days of receiving a statement and supporting documents by the Engineer subject to the condition that last interim payment certificate has been settled after detailed check. In the event of the contractor submitting bills based on false measurements, Project Director should issue a written warning to him to the effect that the facility of 70% payment without detailed check will be withdrawn in future. If the contractor repeats the misconduct this facility should be withdrawn.

(ii) The amount certified in each Interim Payment Certificate within 56 days after the Engineer receives the Statement and supporting documents. Any discrepancy shall be rectified in the next payment to the Contractor; and

(c) the amount certified in the Final Payment Certificate within 56 days after the Employer receives this Payment Certificate or, 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.

Payment of the amount due, unless specified in the Contract Data, shall be made in INR into the bank account, nominated by the Contractor except for the Contract where the Contractor has opted for payment through Letter of Credit (LC) arrangement. In such a case, the procedure for payment shall be as prescribed in clause 14.7.1 below.

However, in case of JV, direct payment to individual JV partners shall be made on joint certification (about the net amounts payable to individual partners) by the authorized representative of the JV and concerned respective authorized representative of individual JV partners, after making requisite recoveries/deductions from the gross payment. In case of any dispute regarding the net amounts payable to individual partners, the

Engineer shall decide the same on the basis of the execution of items of works under Schedules/Bills indicated in the JV agreement as the responsibility of execution of each JV partner. Payment to individual JV partners shall be treated as payment made to the JV. The said payment shall not alter any obligation of the JV and its individual Partners under the Agreement and their obligations under the agreement shall remain joint and several.

A foreign company (either single entity or JV partner), shall have to submit proof of having opened their project office in India before any payment (including advance payment) is released to such a company. The required proof here shall be a copy of the report containing information as per format prescribed by Reserve Bank of India submitted to the Director General of Police (DGP) of the state concerned in which project office has been established.

Procedure for payment through LC:

14.7.1

(i) The LC shall be a sight LC.

(ii) The contractor shall select his Advising/Negotiating bank for LC. The incidental cost towards issue of LC and its operation thereof shall be borne by the contractor.

(iii) The Employer's Bank and its nodal branch for issue of LCs based on requests received from Employer Accounts Units shall be as indicated in the Contract Data. The Branch office of the Employer's Bank, where the Employer Accounts Office has its Account, as indicated in the Contract Data, will be the issuance/reimbursing branch for LC issued under this arrangement. The Bank shall remain same for this tender till completion of contract. The present incidental cost @ 0.15% per annum of LC value or any increase/decrease by the banks for issue of LC and operation thereof shall be borne by the contractor and shall be recovered from his Interim Payment Certificates.

(iv) The LC shall be opened initially for duration of 180 to 365 days in consultation with contractor. The LC shall be extended time to time as per the progress of the contract, on the request of the contractor. The value of LC to be opened initially as well as extended thereafter shall be finalized by the engineer in consultation with the contractor on the basis of expected progress of work.

(v) The LC terms and conditions shall inter-alia indemnify and save harmless the Employer from and against all losses, claims and demands of every nature and description brought or recovered against the Employer by reason of any act or omission of the contractor, his agents or employees, in relation to the Letter of Credit (LC). All sums payable/borne by Employer on this account shall be considered as reasonable compensation and paid by contractor.

(vi) The LC terms and conditions shall inter-alia provide that Employer will issue a Document of Authorisation (in the format decided in consultation with the Employer's Bank) after passing the Interim Payment Certificate for completed work, to enable contractor to claim the authorized amount from their bank.

(vii) The acceptable, agreed upon document for payments to be released under the LC shall be the Document of Authorisation.

(viii) The Document of Authorisation shall be issued by Employer Accounts Office against each Interim Payment Certificate passed by Employers.

(ix) On issuance of document of Authorisation, a copy of Document of Authorization shall be sent to the contractor. A copy of Document of Authorisation shall also be sent by Employer Accounts Office to Employer's bank.

(x) On receipt of Document of Authorization, the contractor shall present his claim to his bank (advising Bank) for necessary payments as per LC terms and conditions. The claim shall comprise of copy of Document of Authorization, Bill of Exchange and Payment Certificate.

(xi) The payment against LC shall be subject to verification from Employer's Bank .

(xii) The contractor's bank (advising bank) shall submit the documents to the Employer's Bank .

(xiii) The Employer's bank (Issuing Bank) shall, after verifying the claim so received w.r.t. the Document of Authorisation received from Employer Accounts Office release the payment to contractor's bank (advising bank) for crediting the same to contractor's account.

(xiv) Any number of Interim Payment Certificates can be dealt within one LC, provided the sum total of payments to contractor is within the amount for which LC has been opened.

(xv) The LC shall be closed after the release of Final Payment certificate including PVC amount, if any, to the contractor.

(xvi) In case of JV, LC shall be opened in the name of JV and option of direct payment to individual JV partners through LC shall not be permissible.

14.8 Delayed Payment If the Contractor does not receive payment in accordance with Sub-Clause 14.7 [Payment], the Contractor shall be entitled to receive interest on the

amount unpaid during the period of delay. This period shall be deemed to commence on the date for payment specified in Sub-Clause 14.7 [Payment], irrespective (in the case of its sub-paragraph (b)) of the date on which any Interim Payment Certificate is issued.

Unless otherwise stated in the Special Conditions of Contract, the interest amount be calculated at the rate specified in the Contract Data. If no rate is specified in the Contract Data the clause shall not apply.

The Contractor shall be entitled to this payment without formal notice or certification, and without prejudice to any other right or remedy.

14.9 Payment of Retention Money

The Retention Money shall be certified and paid with the final payment certificate or bank guarantee against retention money shall be released, after making required adjustments for recovery for shortage/excess materials, if any **(except those quantities which become surplus due to change in planning/scheme by Railway/EMPLOYER) in case the recovery for surplus/excess materials is still balance after adjusting the amount payable in the final payment certificate.**

The contractor shall be entitled to substitute a bank guarantee in the form approved by the Employer with the retention money amount recovered upto the date of request. Such substitution shall be permissible maximum upto 3 times. The Bank Guarantee shall be valid upto end of Defect Liability Period. In case of extension of date of completion of contract, the Contractor shall extend the validity of the Bank Guarantee(s) until the revised end of Defect Liability Period.

Wherever the contract is terminated under Clause 15.2, the Retention Money shall be forfeited and the balance work should be got done separately.

14.10 Statement at Completion

Within 84 days after receiving the Taking-Over Certificate for the Works, the Contractor shall submit to the Engineer six copies of a Statement at completion with supporting documents, in accordance with Sub-Clause 14.3 [Application for Interim Payment Certificates], showing:

(a) the value of all work done in accordance with the Contract up to the date stated in the Taking-Over Certificate for the Works,

(b) any further sums which the Contractor considers to be due, and

(c) an estimate of any other amounts which the Contractor considers will become due to him under the Contract. Estimated amounts shall be shown separately in this Statement at completion.

The Engineer shall then certify in accordance with Sub-Clause 14.6 [Issue of Interim Payment Certificates].

Within 56 days after receiving the Performance Certificate, the Contractor shallsubmit, to the Engineer, six copies of a draft final statement as per procedure prescribed by the Engineer, with supporting documents showing in detail in a form approved by the Engineer:

14.11 Application for Final Payment Certificate

Within 56 days after receiving the Performance Certificate, the Contractor shall submit, to the Engineer, six copies of a draft final statement as per procedure prescribed by the Engineer, with supporting documents (including Contractor's certificate in terms of Sub-Clause 6.22 (ii)) showing in detail in a form approved by the Engineer:

(a) the value of all work done in accordance with the Contract, and

(b) any further sums which the Contractor considers to be due to him under the Contract or otherwise, and

(c) the final statement of local content after completion of works in Form-MII provided in Section 4 Bidding Forms.

If the Engineer disagrees with or cannot verify any part of the draft final statement, as per procedure prescribed by the Engineer the Contractor shall submit such further information as the Engineer may reasonably require and shall make such changes in the draft as may be agreed between them. The Contractor shall then prepare and submit to the Engineer the final statement as agreed. This agreed statement is referred to in these Conditions as the "Final Statement".

However if, following discussions between the Engineer and the Contractor and any changes to the draft final statement which are agreed, it becomes evident that a dispute exists, the Engineer shall deliver to the Employer (with a copy to the Contractor) an Interim Payment Certificate for the agreed parts of the draft final statement. Thereafter, if the dispute is finally resolved under Sub-Clause 20.3 [Obtaining Dispute Board's Decision] or Sub-Clause 20.2 [Amicable Settlement], the Contractor shall then prepare and submit to the Employer (with a copy to the Engineer) a Final Statement.

14.12 Discharge

When submitting the Final Statement, the Contractor shall submit a discharge which confirms that the total of the Final Statement represents full and final settlement of all moneys due to the Contractor under or in connection with the Contract. This discharge may state that it becomes effective when the Contractor has received the Performance Security and the outstanding balance of this total, in which event the discharge shall be effective on such date.

14.13 Issue of Final Payment Certificate

Within 28 days after receiving the Final Statement and discharge in accordance with Sub-Clause 14.11 [Application for Final Payment Certificate] and Sub-Clause 14.12 [Discharge], the Engineer shall issue, to the Employer, the Final Payment Certificate which shall state:

(a) the amount which he fairly determines is finally due, and

(b) after giving credit to the Employer for all amounts previously paid by the Employer and for all sums to which the Employer is entitled, the balance (if any) due from the Employer to the Contractor or from the Contractor to the Employer, as the case may be.

If the Contractor has not applied for a Final Payment Certificate in accordance with Sub-Clause 14.11 [Application for Final Payment Certificate] and Sub-Clause 14.12 [Discharge], the Engineer shall request the Contractor to do so. If the Contractor fails to submit an application within a period of 28 days, the

Engineer shall issue the Final Payment Certificate for such amount as he fairly determines to be due.

14.14 Cessation of Employer's Liability

The Employer shall not be liable to the Contractor for any matter or thing under or inconnection with the Contract or execution of the Works, except to the extent that the Contractor shall have included an amount expressly for it:

(a) in the Final Statement and also

(b) (except for matters or things arising after the issue of the Taking-Over Certificate for the Works) in the Statement at completion described in Sub-Clause 14.10 [Statement at Completion].

However, this Sub-Clause shall not limit the Employer's liability under his indemnification obligations, or the Employer's liability in any case of fraud, deliberate default or reckless misconduct by the Employer.

14.15 Currencies of Payment

The Contract Price shall be paid in Indian Rupees (INR).

15. Termination by Employer

15.1 Notice to Correct

If the Contractor fails to carry out any obligation under the Contract as mentioned below, but not limited to, the Engineer/ Employer may serve the contractor with a 14 days notice in writing calling upon the contractor to make good the failure and to remedy it. If the contractor;

(a) fails to comply with Sub-Clause 4.2 [Performance Security],

(b) abandons the Works or otherwise plainly demonstrates the intention not to continue performance of his obligations under the Contract,

(c) without reasonable excuse fails to:

(i) proceed with the Works in accordance with Clause 8 [Commencement, Delays and Suspension], or

(ii) comply with a notice issued under Sub-Clause 7.5 [Rejection] or Sub-Clause 7.6 [Remedial Work], within 28 days after receiving it, or

(iii) adhere to the agreed programme of work / activity on the critical path, by a margin of 10% of the stipulated period, or

(iv) take steps to deploy competent and adequate number of personnel, and equipment to achieve progress as per agreed programme or

(v) adhere to the instructions of Engineers/Employer persistently or

(vi) comply any provision of the contract or

(vii) provide the Engineer/Employer or their representative proper facilities for inspecting the works or any part thereof as required, under Clause 7.3 (Inspection) and 7.4 (Testing).

(d) subcontracts the whole or major part of the Works or assigns the Contract without prior written consent of the Employer.,

If the contractor does not, within 14 days of receipt of notice under this sub-clause, proceed to make good his default in so far as the same is capable of being made good and carry on the work of complying with such direction as contained in the notice under sub clause 15.1, to the entire satisfaction of the Engineer/Employer, the Employer shall be entitled to take action under sub-clause 15.1.1 or 15.1.2 or 15.2 below.

15.1.1 In case of contractor's repeated failure to adhere to the agreed program, and whereas the contractor has been served with a Notice to Correct under Clause 15.1 of GCC, if the contractor approaches EMPLOYER with a revised program with specific monthly physical and financial targets along with the proposal to deploy matching inputs in the form of manpower and other resources to the satisfaction of the Employer, then the Employer may consider whether to proceed with termination of the contract under Clause 15.2 of GCC or to continue with the contract. However, the request to continue with the contract shall only be considered if the contractor supports his earnestness to adhere to the revised program by submitting additional Performance Security in the form of Bank Guarantee(s) of specified number and value as decided by the Employer (total value of which will not exceed 10% of the contract price). The encashment of these additional Bank Guarantee(s) shall be linked with the non achievement of agreed physical/financial targets agreed upon by the Contractor and the Employer.

15.1.2 In case the contractor's failure is limited to only some of the works, and in response to Notice to Correct under Clause 15.1 of GCC, the contractor approaches the Employer that such works may be offloaded from him and got executed through another agency and additional cost incurred, if any, should be recovered from his dues, the Employer, on being convinced that the anticipated additional cost for such works will not be substantial and can be recovered from the dues of the contractor and that such offloading will help in improving the overall progress of the project, may agree to such offloading without any repercussion on the performance security and/or additional bank guarantees, if any, submitted by the contractor. However, the Employer will not be under any compulsion to agree to such a request. The Contractor shall be informed of the LOA issued to other agency(ies) for such works.

In case the contractor does not approach the employer for offloading but the Employer is convinced that:

(i) offloading of some works will help in improving the progress of the project;

(ii) termination/part termination of the contract at this stage will not be in the interest of the project;

(iii) the anticipated additional cost for such works will not be substantial and can be recovered from the dues of the contractor;

The Employer may issue 7 days notice to the Contractor stating the resources required to be deployed against each work. If the contractor fails to deploy the required resources as indicated in the notice, the employer shall offload such works and proceed with getting the works executed through other agency(ies). The Contractor shall be informed of the LOA issued to other agency(ies) for such works.

Offloading under the sub clause 15.1.2 shall be without any repercussion on the performance security and/or additional bank guarantees, if any, submitted by the contractor. The Contractor would have no future claim on this account and the extra expenditure so incurred, if any, by the Employer in getting the offloaded work done, shall be recovered from subsequent payment certificates or any other dues of the contractor.

15.2 Termination by Employer

The Employer shall be entitled to terminate the Contract as a whole or any part or parts (as may be specified in the Notice of Termination under any of the above Sub-Clause issue) if the Contractor:

(a) fails to comply with the directions contained in the notice under Sub-Clause 15.1 [Notice to Correct],

(b) becomes bankrupt or insolvent, goes into liquidation, has a receiving or administration order made against it by Court or Statutory Authority him, compounds with his creditors, or carries on business under a receiver, trustee or manager for the benefit of his creditors, or if any act is done or event occurs which (under applicable Laws) has a similar effect to any of these acts or events, or

(c) gives or offers to give (directly or indirectly) to any person any bribe, gift, gratuity, commission or other thing of value, as an inducement or reward:

  (i) for doing or forbearing to do any action in relation to the Contract, or

  (ii) for showing or forbearing to show favour or disfavour to any person in relation to the Contract,

or if any of the Contractor's Personnel, agents or Subcontractors gives or offers to give (directly or indirectly) to any person any such inducement or reward as is described in this sub-paragraph (c). However, lawful inducements and rewards to Contractor's Personnel shall not entitle termination

In any of these events or circumstances, the Employer may, by Notice Terminate the contract with immediate effect.

The Employer's election to terminate the Contract shall not prejudice any other rights of the Employer, under the Contract or otherwise.

The Contractor shall remove all his plants and machinery from the site then leave the Site and deliver any required Goods, all Contractors' Documents, and other design documents made by or for him, to the Engineer within 7 days from the issue of Notice of Termination, failing which Delay Damages as prescribed for delay in completion of works shall be imposed as per provision of clause 8.7. However, the Contractor shall use his best efforts to comply immediately with any reasonable instructions included in the notice of Termination (i) for the assignment of any subcontract, and (ii) for the protection of life or property or for the safety of the Works.

After termination, the Employer may complete the Works and/or arrange for any other entities to do so. The Employer and these entities may then use any Goods,

Contractor's Documents and other design documents made by or on behalf of the Contractor for completing the work.

15.3 Valuation at Date of Termination

As soon as practicable after a notice of termination under Sub-Clause 15.2 [Termination by Employer] has taken effect, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine the value of the Works, Goods and Contractor's Documents, and any other sums due to the Contractor for work executed in accordance with the Contract. For this purpose, the contractor shall be notified the date for witnessing of measurements and handing over of the materials for which contractor has already been paid. In case the contractor fails to attend or send a representative even after such notice, the Engineer shall ex parte proceed with measurements of the works executed and taking over of plants and materials etc. for which payment has already been made to the contractor, which shall be treated as final.

15.4 Payment after Termination

After a notice of termination under Sub-Clause 15.2 [Termination by Employer] has taken effect, the Employer may:

(a) proceed in accordance with Sub-Clause 2.5 [Employer's Claims],

(b) encash the Performance Guarantee and forfeit the Performance

Security:

i) In full including additional Performance Guarantee amount if any taken in terms of sub clause 35.5 of ITBand not due for release on the date of issue of termination letter, in case of termination of the contract as a whole; Or

ii) in part/parts proportionate to the contract price of the bill/schedule to which the terminated part of work belongs i.e.

P = (A x B) ÷ C where,

P = Proportionate Bank Guarantee Amount

A = Contract Price of the particular bill/schedule to which the terminated part of work belongs

B = Performance Guarantee amount in terms of GCC sub clause 4.2

C = Total Contract Price

Plus additional Performance Guarantee amount if any taken in terms of sub clause 35.5 of ITB and not due for release on the date of issue of termination letter against that particular bill/Schedule to which the terminated part of the work belongs in case of termination in part/parts.

(c) release any payment due to the contractor for works executed prior to termination and evaluation under clause 15.3 (valuation at date of termination, however, if by this time the Contractor has failed to make a payment due to the Employer, the same will be deducted from the payment due and any balance remaining shall then be paid to the Contractor.).

15.5 Employer's Entitlement to Termination for Convenience

The Employer shall be entitled to terminate the Contract, at any time for the Employer's convenience, by giving notice of such termination to the Contractor. The termination shall take effect 28 days after the later of the dates on which the Contractor receives this notice or the Employer returns the Performance Security. The Employer shall not terminate the Contract under this Sub-Clause in order to execute the Works himself or to arrange for the Works to be executed by another contractor or to avoid a termination of the Contract by the Contractor under Clause 16.2 [Termination by Contractor].

After this termination, the Contractor shall proceed in accordance with Sub-Clause 16.3 [Cessation of Work and Removal of Contractor's Equipment] and shall be paid in accordance with Sub-Clause 19.1 [Payment and Release in case of Optional Termination].

15.6 Corrupt or Fraudulent Practices

If the Employer determines that the Contractor has engaged in corrupt, fraudulent, collusive or coercive practices, in competing for or in executing the Contract, then the Employer may, after giving 14 days notice to the Contractor, terminate the Contractor's employment under the Contract and expel him from the Site, and the provisions of Clause 15 shall apply as if such expulsion had been made under Sub-Clause 15.2.

For the purposes of this Sub-Clause:

(a) *"corrupt practice" means the offering, giving, receiving of soliciting of any thing of "value to influence the action of a public official in the procurement process or in the Contract execution.*

(b) *"fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of the Contract to the detriment of the Employer, and includes collusive practice among Bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the Employer of the benefits of free and open competition.*

(c) *"collusive practice" means a scheme or arrangement between two or more bidders, with or without the knowledge of the Employer, designed to establish bid prices at artificial, noncompetitive levels.*

(d) *"coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the procurement process or affect the execution of a contract.*

16. Suspension and Termination by Contractor

16.1 Contractor's Entitlement to Suspend Work

If the Engineer fails to certify in accordance with Sub-Clause 14.6 [Issue of Interim Payment Certificates] or the Employer fails to comply with Sub-Clause 2.4 [Employer's Financial Arrangements] or Sub-Clause 14.7 [Payment], the Contractor may, after giving not less than 21 days' notice to the Employer, suspend work (or reduce the rate of work) unless and until the Contractor has received the Payment Certificate, reasonable evidence or payment, as the case may be and as described in the notice.

The Contractor's action shall not prejudice his entitlements to interest under Sub-Clause 14.8 [Delayed Payment] and to termination under Sub-Clause 16.2 [Termination by Contractor].

If the Contractor subsequently receives such Payment Certificate, evidence or payment (as described in the relevant Sub-Clause and in the above notice) before giving a notice of termination, the Contractor shall resume normal working as soon as is reasonably practicable.

If the Contractor suffers delay and/or incurs Cost as a result of suspending work (or reducing the rate of work) in accordance with this Sub-Clause, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost plus profit, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

16.2 Termination by Contractor

The Contractor shall be entitled to terminate the Contract if:

(a) the Contractor does not receive the reasonable evidence within 42 days after giving notice under Sub-Clause 16.1 [Contractor's Entitlement to Suspend Work] in respect of a failure to comply with Sub-Clause 2.4 [Employer's Financial Arrangements],

(b) the Engineer fails, within 56 days after receiving a Statement and supporting documents, to issue the relevant Payment Certificate,

(c) the Contractor does not receive the amount due under an Interim Payment Certificate within 42 days after the expiry of the time stated in Sub-Clause 14.7 [Payment] within which payment is to be made (except for deductions in accordance with Sub-Clause 2.5 [Employer's Claims]),

(d) a prolonged suspension affects the whole of the Works as described in Sub-Clause 8.11 [Prolonged Suspension], or

(e) the Employer becomes bankrupt or insolvent, goes into liquidation, has a receiving or administration order made against him, compounds with his creditors, or carries on business under a receiver, trustee or manager for the benefit of his creditors, or if any act is done or event occurs which (under applicable Laws) has a similar effect to any of these acts or events.

In any of these events or circumstances, the Contractor may, upon giving 14 days' notice to the Employer, terminate the Contract. However, in the case of sub-paragraph (d) or (e), the Contractor may by notice terminate the Contract immediately.

The Contractor's election to terminate the Contract shall not prejudice any other rights of the Contractor, under the Contract or otherwise.

16.3 Cessation of Work and Removal of Contractor's Equipment

After a notice of termination under Sub-Clause 15.5 [Employer's Entitlement to Termination], Sub-Clause 16.2 [Termination by Contractor] or Sub-Clause 19.1 [Optional Termination, Payment and Release] has taken effect, the Contractor shall promptly:

(a) cease all further work, except for such work as may have been instructed by the Engineer for the protection of life or property or for the safety of the Works,

(b) hand over Contractor's Documents, Plant, Materials and other work, for which the Contractor has received payment, and

(c) remove all other Goods from the Site, except as necessary for safety, and leave the Site.

16.4 Payment on Termination

After a notice of termination under Sub-Clause 16.2 [Termination by Contractor] has taken effect, the Employer shall promptly:

(a) return the Performance Security to the Contractor,

(b) pay the Contractor in accordance with Sub-Clause 19.1 [Optional Termination, Payment and Release], and

(c) should the contract be terminated under sub-clause 15.5 of this clause and the contractor claims payment for expenditure incurred by him in the expectation of completing the whole of the work, the Employer shall admit and consider such claims as are deemed reasonable and are supported by vouchers to the satisfaction of the Engineer. The Employer's decision on the necessity and propriety of such expenditure shall be final and conclusive.

(d) The Contractor shall have no claim to any payment of compensation or otherwise, howsoever on account of any profit or advantage which he might have derived from the execution of the work in full but which he did not derive in consequence of termination of contract.

17. Risk and Responsibility

17.1 Indemnities

The Contractor shall indemnify and hold harmless the Employer, the Employer's Personnel, and their respective agents, against and from all claims, damages, losses and expenses (including legal fees and expenses) in respect of:

(a) bodily injury, sickness, disease or death, of any person including railway user whatsoever arising out of or in the course of or by reason of the Contractor's design (if any), the execution and completion of the Works and the remedying of any defects, unless attributable to any negligence, wilful act or breach of the Contract by the Employer, the Employer's Personnel, or any of their respective agents, and

(b) damage to or loss of any property, real or personal (other than the Works), to the extent that such damage or loss arises out of or in the course of or by reason of the Contractor's design (if any), the execution and completion of the Works and the remedying of any defects, unless and to the extent that any such damage or loss is attributable to any negligence, wilful act or breach of the Contract by the Employer, the Employer's Personnel,, their respective agents, or anyone directly or indirectly employed by any of them.

The Employer shall indemnify and hold harmless the Contractor, the Contractor's Personnel, and their respective agents, against and from all claims, damages, losses and expenses (including legal fees and expenses) in respect of (1) bodily injury, sickness, disease or death, which is attributable to any negligence, wilful act or breach of the Contract by the Employer, the Employer's Personnel, or any of their respective agents, and (2) the matters for which liability may be excluded from insurance cover, as described in sub-paragraphs (d)(i), (ii) and (iii) of Sub-Clause 18.3 [Insurance Against Injury to Persons and Damage to Property].

17.2 Contractor's Care of the Works

The Contractor shall take full responsibility for the care of the Works and Goods from the Commencement Date until the Taking-Over Certificate is issued (or is deemed to be issued under Sub-Clause 10.1 [Taking Over of the Works and Sections]) for the Works, when responsibility for the care of the Works shall pass to the Employer. If a Taking-Over Certificate is issued (or is so deemed to be issued) for any Section or part of the Works, responsibility for the care of the Section or part shall then pass to the Employer.

After responsibility has accordingly passed to the Employer, the Contractor shall take responsibility for the care of any work which is outstanding on the date stated in a Taking-Over Certificate, until this outstanding work has been completed.

If any loss or damage happens to the Works, Goods or Contractor's Documents during the period when the Contractor is responsible for their care, from any cause not listed in Sub-Clause 17.3 [Employer's Risks], the Contractor shall rectify the loss or damage at the Contractor's risk and cost, so that the Works, Goods and Contractor's Documents conform with the Contract.

The Contractor shall be liable for any loss or damage caused by any actions performed by the Contractor after a Taking-Over Certificate has been issued. The Contractor shall also be liable for any loss or damage which occurs after a Taking-Over Certificate has been issued and which arose from a previous event for which the Contractor was liable.

17.3 Employer's Risks

The risks referred to in Sub-Clause 17.4 below, insofar as they directly affect the execution of the works in the Country, are:

(a) war, hostilities (whether war be declared or not), invasion, act of foreign enemies,

(b) rebellion, terrorism, sabotage by persons other than the Contractor's Personnel, revolution, insurrection, military or usurped power, or civil war, within the Country,

(c) riot, commotion or disorder within the Country by persons other than the Contractor's Personnel,

(d) munitions of war, explosive materials, ionising radiation or contamination by radio-activity, within the Country, except as may be attributable to the Contractor's use of such munitions, explosives, radiation or radio-activity,

(e) pressure waves caused by aircraft or other aerial devices travelling at sonic or supersonic speeds,

(f) use or occupation by the Employer of any part of the Permanent Works, except as may be specified in the Contract,

(g) design of any part of the Works by the Employer's Personnel or by others for whom the Employer is responsible, and

(h) any operation of the forces of nature which is Unforeseeable or against which an experienced contractor could not reasonably have been expected to have taken adequate preventative precautions.

17.4 Consequences of Employer's Risks

If and to the extent that any of the risks listed in Sub-Clause 17.3 above results in loss or damage to the Works, Goods or Contractor's Documents, the Contractor shallpromptly give notice to the Engineer and shall rectify this loss or damage to the extent required by the Engineer.

If the Contractor suffers delay and/or incurs Cost from rectifying this loss or damage, the Contractor shall give a further notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price. In the case of sub-paragraphs (f) and (g) of Sub-Clause 17.3 [Employer's Risks], Cost shall be payable.

After receiving this further notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

17.5 Intellectual and Industrial Property Rights

In this Sub-Clause, "infringement" means an infringement (or alleged infringement) ofany patent, registered design, copyright, trade mark, trade name, trade secret or other intellectual or industrial property right relating to the Works; and "claim" means a claim (or proceedings pursuing a claim) alleging an infringement.

Whenever a Party does not give notice to the other Party of any claim within 28 days of receiving the claim, the first Party shall be deemed to have waived any right to indemnity under this Sub-Clause.

The Employer shall indemnify and hold the Contractor harmless against and from any claim alleging an infringement which is or was:

(a) an unavoidable result of the Contractor's compliance with the Contract, or

(b) a result of any Works being used by the Employer:

(i) for a purpose other than that indicated by, or reasonably to be inferred from, the Contract, or

(ii) in conjunction with any thing not supplied by the Contractor, unless such use was disclosed to the Contractor prior to the Base Date or is stated in the Contract.

The Contractor shall indemnify and hold the Employer harmless against and from any other claim which arises out of or in relation to (i) the manufacture, use, sale or import of any Goods, or (ii) any design for which the Contractor is responsible.

If a Party is entitled to be indemnified under this Sub-Clause, the indemnifying Party may (at its cost) conduct negotiations for the settlement of the claim, and any litigation or arbitration which may arise from it. The other Party shall, at the request and cost of the indemnifying Party, assist in contesting the claim. This other Party (and its Personnel) shall not make any admission which might be prejudicial to the indemnifying Party, unless the indemnifying Party failed to take over the conduct of any negotiations, litigation or arbitration upon being requested to do so by such other Party.

17.6 Limitation of Liability

Neither Party shall be liable to the other Party for loss of use of any Works, loss of profit, loss of any contract or for any indirect or consequential loss or damage which may be suffered by the other Party in connection with the Contract, provided that this exclusion shall not apply to any obligation of the Contractor to pay Delay Damages to the Employer under Sub-Clause 8.7 [Delay Damages].

The total liability of the Contractor to the Employer, under or in connection with the Contract other than under Sub-Clause 4.19 [Electricity, Water and Gas], Sub-Clause 4.20 [Employer's Equipment and Free-Issue Material], Sub-Clause 17.1 [Indemnities] and Sub-Clause 17.5 [Intellectual and Industrial Property Rights], shall not exceed the sum as specified in the Contract Data or if nothing is specified in the Contract Data, the accepted Contract Amount.

This Sub-Clause shall not limit liability in any case of fraud, deliberate default or reckless misconduct by the defaulting Party.

17.7 Use of Employer's Accommodation/ Facilities

The Contractor shall take full responsibility for the care of the Employer provided accommodation and facilities, if any, as detailed in the Specification, 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 his own cost, rectify the loss or damage to the satisfaction of the Engineer.

18. Insurance

18.1 General Requirements for Insurances

In this Clause, "insuring Party" means, for each type of insurance, the Party responsible for effecting and maintaining the insurance specified in the relevant Sub-Clause.

Wherever the Contractor is the insuring Party, each insurance shall be effected with insurers and in terms approved by the Employer. These terms shall be consistent with any terms agreed by both Parties before the date of the Letter of Acceptance. This agreement of terms shall take precedence over the provisions of this Clause.

Wherever the Employer is the insuring Party, each insurance shall be effected with insurers and in terms consistent with the details annexed to the Special Conditions of Contract.

If a policy is required to indemnify joint insured, the cover shall apply separately to each insured as though a separate policy had been issued for each of the joint insured. If a policy indemnifies additional joint insured, namely in addition to the insured specified in this Clause, (i) the Contractor shall act under the policy on behalf of these additional joint insured except that the Employer shall act for Employer's Personnel, (ii) additional joint insured shall not be entitled to receive payments directly from the insurer or to have any other direct dealings with the insurer, and (iii) the insuring Party shall require all additional joint insured to comply with the conditions stipulated in the policy.

Each policy insuring against loss or damage shall provide for payments to be made in the currencies required to rectify the loss or damage. Payments received from insurers shall be used for the rectification of the loss or damage.

The relevant insuring Party shall, within the respective periods stated in the Contract Data (calculated from the Commencement Date), submit to the other Party:

(a) evidence that the insurances described in this Clause have been effected, and

(b) copies of the policies for the insurances described in Sub-Clause 18.2 [Insurance for Works and Contractor's Equipment] and Sub-Clause 18.3 [Insurance against Injury to Persons and Damage to Property].

(c) If the contractor fails to submit evidence and copies of the policies as mentioned in (a) & (b) above to prove that the policies have been obtained within the period specified in the contract data, and submits the same later on and from the submitted evidence it is found that the policies have not been obtained within the period specified, the

Employer shall recover double the cost of the premium for the period the policies have been delayed.

When each premium is paid, the insuring Party shall submit evidence of payment to the other Party. Whenever evidence or policies are submitted, the insuring Party shall also give notice to the Engineer.

Each Party shall comply with the conditions stipulated in each of the insurance policies. The insuring Party shall keep the insurers informed of any relevant changes to the execution of the Works and ensure that insurance is maintained in accordance with this Clause.

Neither Party shall make any material alteration to the terms of any insurance without the prior approval of the other Party. If an insurer makes (or attempts to make) any alteration, the Party first notified by the insurer shall promptly give notice to the other Party.

If the insuring Party fails to effect and keep in force any of the insurances it is required to effect and maintain under the Contract, or fails to provide satisfactory evidence and copies of policies in accordance with this Sub-Clause, the other Party may (at its option and without prejudice to any other right or remedy) effect insurance for the relevant coverage and pay the premiums due. The insuring Party shall pay double the amount of these premiums to the other Party, and the Contract Price shall be adjusted accordingly.

Nothing in this Clause limits the obligations, liabilities or responsibilities of the Contractor or the Employer, under the other terms of the Contract or otherwise. Any amounts not insured or not recovered from the insurers shall be borne by the Contractor and/or the Employer in accordance with these obligations, liabilities or responsibilities. However, if the insuring Party fails to effect and keep in force an insurance which is available and which it is required to effect and maintain under the Contract, and the other Party neither approves the omission nor effects insurance for the coverage relevant to this default, any moneys which should have been recoverable under this insurance shall be paid by the insuring Party.

Payments by one Party to the other Party shall be subject to Sub-Clause 2.5 [Employer's Claims] or Sub-Clause 20.1 [Contractor's Claims], as applicable.

The Contractor shall be entitled to place all insurance relating to the Contract (including, but not limited to the insurance referred to Clause 18) with insurers from any eligible source country.

18.2 Insurance for Works and Contractor's Equipment

The Contractor shall insure the Works, Plant, Materials, including those issued by the Employer and Contractor's Documents for not less than the full reinstatement cost including the costs of demolition, removal of debris and professional fees and profit, subject to a maximum value indicated in Contract Data**.**. This insurance shall be effective from the date by which the evidence is to be submitted under sub-paragraph (a) of Sub-Clause 18.1 [General Requirements for Insurances], until the date of issue of the Taking-Over Certificate for the Works.

The insuring Party shall maintain this insurance to provide cover until the date of issue of the Performance Certificate, for loss or damage for which the Contractor

is liable arising from a cause occurring prior to the issue of the Taking-Over Certificate, and for loss or damage caused by the Contractor in the course of any other operations (including those under Clause 11 [Defects Liability]).

The insuring Party shall insure the Contractor's Equipment for not less than the full replacement value, including delivery to Site. For each item of Contractor's Equipment, the insurance shall be effective while it is being transported to the Site and until it is no longer required as Contractor's Equipment.

Unless otherwise stated in the Special Conditions of Contract, insurances under this Sub-Clause:

(a) shall be effected and maintained by the Contractor as insuring Party,

(b) shall be in the joint names of the Parties, who shall be jointly entitled to receive payments from the insurers, payments being held or allocated between the Parties for the sole purpose of rectifying the loss or damage,

(c) shall cover all loss and damage from any cause not listed in Sub-Clause 17.3 [Employer's Risks],

(d) shall also cover loss or damage to a part of the Works which is attributable to the use or occupation by the Employer of another part of the Works, and loss or damage from the risks listed in sub-paragraphs (c), (g) and (h) of Sub-Clause 17.3 [Employer's Risks], excluding (in each case) risks which are not insurable at commercially reasonable terms, with deductibles per occurrence of not more than the amount stated in the Contract Data (if an amount is not so stated, this sub-paragraph (d) shall not apply), and

(e) may however exclude loss of, damage to, and reinstatement of:

i) part of the Works which is in a defective condition due to a defect in its design, materials or workmanship (but cover shall include any other parts which are lost or damaged as a direct result of this defective condition and not as described in sub-paragraph (ii) below),

ii) a part of the Works which is lost or damaged in order to reinstate any other part of the Works if this other part is in a defective condition due to a defect in its design, materials or workmanship,

iii) a part of the Works which has been taken over by the Employer, except to the extent that the Contractor is liable for the loss or damage, and

iv) Goods while they are not in the Country, subject to Sub-Clause 14.5 [Plant and Materials intended for the Works].

If, more than one year after the Base Date, the cover described in sub-paragraph (d) above ceases to be available at commercially reasonable terms, the Contractor shall (as insuring Party) give notice to the Employer, with supporting particulars. The Employer shall then (i) be entitled subject to Sub-Clause 2.5 [Employer's Claims] to payment of an amount equivalent to such commercially reasonable terms as the Contractor should have expected to have paid for such cover, and (ii) be deemed, unless he obtains the cover at commercially reasonable terms, to have approved the omission under Sub-Clause 18.1 [General Requirements for Insurances].

18.3 Insurance against Injury to Persons and Damage to Property

The insuring Party shall insure against each Party's liability for any loss, damage, death or bodily injury which may occur to any physical property (except things insured under Sub-Clause 18.2 [Insurance for Works and Contractor's Equipment]) or to any person (except persons insured under Sub-Clause 18.4 [Insurance for Contractor's Personnel]), which may arise out of the Contractor's performance of the Contract and occurring before the issue of the Performance Certificate.

This insurance shall be for a limit per occurrence of not less than the amount stated in the Contract Data, with no limit on the number of occurrences. If an amount is not stated in the Contract Data, this Sub-Clause shall not apply.

Unless otherwise stated in the Special Conditions of Contract, the insurances specified in this Sub-Clause:

(a) shall be effected and maintained by the Contractor as insuring Party,

(b) shall be in the joint names of the Parties,

(c) shall be extended to cover liability for all loss and damage to the Employer's property including Railways Property (except things insured under Sub-Clause 18.2) arising out of the Contractor's performance of the Contract, and

(d) may however exclude liability to the extent that it arises from:

(i) the Employer's right to have the Permanent Works executed on, over, under, in or through any land, and to occupy this land for the Permanent Works,

(ii) damage which is an unavoidable result of the Contractor's obligations to execute the Works and remedy any defects, and

(iii) a cause listed in Sub-Clause 17.3 [Employer's Risks], except to the extent that cover is available at commercially reasonable terms.

18.4 **Insurance for Contractor's Personnel**

The Contractor shall abide by the provisions of ESIC Act, 1948 (extended from time to time) to take care of insurance against liability for claims, damages, losses and expenses (including legal fees and expenses) arising from injury, sickness or disease. In addition the contractor shall also maintain insurance against liability for claim of death of any person employed by the Contractor or any other of the Contractor's Personnel.

The Employer and the Engineer shall also be indemnified under the policy of insurance, 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.

The insurance shall be maintained in full force and effect during the whole time that these personnel are assisting in the execution of the Works. For a Subcontractor's employees, the insurance may be effected by the Subcontractor, but the Contractor shall be responsible for compliance with this Clause.

19. Force Majeure

If at any time, during the continuance of this contract, the performance in whole or in part by either party of any obligation under this contract shall be prevented or delayed by reason of any war, hostility, acts of public enemy, civil commotion, sabotage, serious loss or damage by fire, explosions, epidemics, strikes, lockouts or acts of God (hereinafter referred to 'events') provided, notice of the

happening of any such event is given by either party to the other within 14 days from the date of occurrence thereof, neither party shall by reason of such event, be entitled to terminate this contract nor shall either party have any claim for damages against the other in respect of such non-performance of delay in performance, and works under the contract shall be resumed as soon as practicable after such event has come to an end or ceased to exist, and decision of the Engineer as to whether the works have been so resumed or not shall be final and conclusive, PROVIDED FURTHER that if the performance in whole or in part of any obligation under this contract is prevented or delayed by reason of any such event for a continuous period exceeding 84 days, either party may at its option terminate the contract by giving notice to the other party.

19.1 Payment and Release in case of Optional Termination

Upon such termination, the Engineer shall determine the value of the work done and issue a Payment Certificate which shall include :

(a) Theamountspayable for any work carried out for which a price is stated in the contract;

(b) TheCost of Plant and Materials ordered for the Works which have been delivered to the Contractor, or of which the contractor is liable to accept delivery; this Plant and materials shall become the property of (and be at the risk of) the Employer when paid for by the Employer, the Contractor shall place the same at the Employer's disposal;

(c) OtherCosts or liabilities supported by necessary documentary evidence which in the circumstances were reasonably and necessarily incurred by the Contractor in the expectation of completing the Works as per mutually agreed programme.

(d) the Cost of removal of Temporary Works and Contractor's Equipment from the Site and the return of these items to the Contractor's works in his country (or to any other destination at no greater cost).

20. Claims, Disputes and Arbitration

20.1 Contractor's Claims

If the Contractor considers himself to be entitled to any extension of the Time for Completion and/or any additional payment, under any Clause of these Conditions or otherwise in connection with the Contract, the Contractor shall give notice to the Engineer, describing the event or circumstance giving rise to the claim. The notice shall be given as soon as practicable, and not later than 28 days after the Contractor became aware, or should have become aware, of the event or circumstance.

If the Contractor fails to give notice of a claim within such period of 28 days, the Time for Completion shall not be extended, the Contractor shall not be entitled to additional payment, and the Employer shall be discharged from all liability in connection with the claim. Otherwise, the following provisions of this Sub-Clause shall apply.

The Contractor shall also submit any other notices which are required by the Contract, and supporting particulars for the claim, all as relevant to such event or circumstance.

The Contractor shall keep such contemporary records as may be necessary to substantiate any claim, either on the Site or at another location acceptable to the Engineer. Without admitting the Employer's liability, the Engineer may, after receiving any notice under this Sub-Clause, monitor the record-keeping and/or instruct the Contractor to keep further contemporary records. The Contractor shall permit the Engineer to inspect all these records, and shall (if instructed) submit copies to the Engineer.

Within 42 days after the Contractor became aware (or should have become aware) of the event or circumstance giving rise to the claim, or within such other period as may be proposed by the Contractor and approved by the Engineer, the Contractor shall send to the Engineer a fully detailed claim which includes full supporting particulars of the basis of the claim and of the extension of time and/or additional payment claimed. If the event or circumstance giving rise to the claim has a continuing effect:

(a) this fully detailed claim shall be considered as interim;

(b) the Contractor shall send further interim claims at monthly intervals, giving the accumulated delay and/or amount claimed, and such further particulars as the Engineer may reasonably require; and

(c) the Contractor shall send a final claim within 28 days after the end of the effects resulting from the event or circumstance, or within such other period as may be proposed by the Contractor and approved by the Engineer.

Within 42 days after receiving a claim or any further particulars supporting a previous claim, or within such other period as may be proposed by the Engineer and approved by the Contractor, the Engineer shall respond with approval, or with disapproval and detailed comments. He may also request any necessary further particulars, but shall nevertheless give his response on the principles of the claim within such time.

Each Payment Certificate shall include such amounts for any claim as have been reasonably substantiated as due under the relevant provision of the Contract. Unless and until the particulars supplied are sufficient to substantiate the whole of the claim, the Contractor shall only be entitled to payment for such part of the claim as he has been able to substantiate.

The Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine (i) the extension (if any) of the Time for Completion (before or after its expiry) in accordance with Sub-Clause 8.4 [Extension of Time for Completion], and/or (ii) the additional payment (if any) to which the Contractor is entitled under the Contract.

The requirements of this Sub-Clause are in addition to those of any other Sub-Clause which may apply to a claim. If the Contractor fails to comply with this or another Sub-Clause in relation to any claim, any extension of time and/or additional payment shall take account of the extent (if any) to which the failure has prevented or prejudiced proper investigation of the claim, unless the claim is excluded under the second paragraph of this Sub-Clause.

20.2 Amicable Settlement

In case any dispute between the Engineer and the Contractor for which claim has already been made by the contractor, remains unresolved, the Contractor shall, then, give notice of dissatisfaction and intention to commence arbitration to the Employer duly specifying the subject of the dispute or difference as also the amount of claim item wise. The Parties shall make attempts to settle the dispute amicably before the commencement of arbitration. However, unless both Parties agree otherwise, demand for arbitration may be made by the

contractor after ninety days from the day on which a notice of dissatisfaction and intention to commence arbitration was given, even if no attempt at amicable settlement has been made.

20.3 Arbitration

Any dispute, in respect of which amicable settlement has not been reached, arising between the Employer and the Domestic or Foreign Contractor related to any matter arising out of or connected with this contract, then the contractor shall be entitled to demand in writing that the dispute or difference be referred to arbitration.

Only such dispute(s) or difference(s) in respect of which the demand had been made for amicable settlement under GCC 20.2 but could not be settled, shall be referred to arbitration subject to the condition that cumulative amount of claims in the contract is not exceeding 20% of the contract price. In case the cumulative amount of claims exceeds 20% of the contract price, arbitration clause will not be applicable.

The Arbitration proceedings shall commence from the day, a written and duly quantified demand for arbitration is received by Managing Director/HORCL (EMPLOYER).

The disputes so referred to arbitration shall be settled in accordance with the Indian Arbitration & Conciliation Act, 1996 and any statutory modification or re-enactment thereof.

Further, it is agreed between the parties as under:

20.3.1 **Number of Arbitrators:** The arbitral tribunal shall consist of three arbitrators.

20.3.2 **Procedure for Appointment of Arbitrators:** The arbitrators shall be appointed as per following procedure:

(a) The Contractor, while invoking demand for arbitration, shall submit to MD/EMPLOYER, claims duly quantified along with name and contact details of his nominee arbitrator. Thereafter, he Employer will nominate his nominee arbitrator within a period of 30 days from receipt of such demand from the Contractor and will issue letter of appointment to both the arbitrators appointed by the parties with a copy to the Contractor.

(b) The third Arbitrator shall be chosen by the two Arbitrators so appointed by the parties and shall act as Presiding Arbitrator. In case of failure of the two Arbitrators appointed by the parties to reach upon consensus within a period of 30 days from the appointment of the Arbitrators subsequently appointed, then, upon the request of either or both parties, the Presiding Arbitrator shall be appointed by the Chairman and Managing Director, Haryana Orbital Rail Corporation Limited.

(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/EMPLOYER fails to act without undue delay, the MD/EMPLOYER 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 re-constituted Tribunal may, at its discretion, proceed with the reference from the stage at which it was left by the previous arbitrator(s).

20.3.3 **Qualification and Experience of Arbitrators (to be appointed as per sub-clause 20.3.2 above):** The contract being of specialized nature requiring knowledge and experience of dealing with construction contracts, the arbitrators to be appointed shall have minimum qualification and experience as under:

Arbitrator shall be;

a working/retired officer (not below E-9 grade and above in a PSU with which EMPLOYER has no business relationship) of any discipline of Engineering or Accounts/Finance department, having experience in Contract Management of construction contracts; or

a retired officer (retired not below the HAG level) of any Engineering/Accounts Services of Central Government, having experience in Contract Management of construction contracts; or a retired officer who should have retired more than 3 years previously from the date of appointment as Arbitrator (retired not below E-9 grade in EMPLOYER or a PSU with which EMPLOYER has a business relationship) of any Engineering discipline or Accounts department, having experience in Contract Management of construction contracts.

No person other than the persons appointed as per above procedure and having above qualification and experience shall act as Arbitrator. In case any person having the qualification and experience other than that mentioned above is nominated as arbitrator, the arbitration clause shall cease to exist and shall not be applicable.

20.3.4 No new claim, except as otherwise mutually agreed by the Parties, shall be added during proceedings by either party. However, a party may amend or supplement the original claim or defence thereof during the course of arbitration proceedings subject to acceptance by Tribunal having due regard to the delay in making it.

Neither party shall be limited in the proceedings before such arbitrators to the evidence nor did arguments previously put before during amicable settlement.

20.3.5 The reference to arbitration may proceed, notwithstanding that the Works shall not then be or be alleged to be complete, provided always that the obligations

20.3.6 of the Employer, the Engineer and the Contractor shall not be altered by the reason of the arbitration being conducted during the progress of the Works. Neither party shall be entitled to suspend the Works, nor shall payment to the Contractor be withheld on account of such proceedings

20.3.7 If the contractor(s) does/do not prefer his/their specific and final claims in writing, within a period of 90 days of receiving the intimation from the Employer/Engineer that the final bill is ready for signature of the contractor(s),

he/they will be deemed to have waived his/their claim(s) and the Employer shall be discharged and released of all liabilities under the contract in respect of these claims.

20.3.8 Arbitration proceedings shall be held at Gurugram, India or at a place where EMPLOYER's (dealing the contract) office is located, and the language of the arbitration proceedings and that of all documents and communications between the parties shall be in English.

20.3.9 The Arbitral Tribunal should record day to day proceedings. The proceedings shall normally be conducted on the basis of documents and written statements.

All arbitration awards shall be in writing and shall state item wise, the sum and detailed reasons upon which it is based.

20.3.10 Any ruling on award shall be made by a majority of members of Tribunal. In the absence of such a majority, the views of the Presiding Arbitrator shall prevail.

A party may apply for correction of any computational errors, any typographical or clerical errors or any other error of similar nature occurring in the award of a tribunal and interpretation of specific point of award to tribunal within 60 days of the receipt of award.

A party may apply to tribunal within 60 days of receipt of award to make an additional award as to claims presented in the arbitral proceedings but omitted from the arbitral award.

20.3.11 Where the Arbitral award is for the payment of money, no interest shall be payable on whole or any part of the money for any period till the date on which the award is made.

20.3.12 The fees and other charges of the conciliator/arbitrators shall be as per the fee structure fixed by the employer (enclosed as Annexure 3 to section 7) and as amended from time to time irrespective of the fact whether the Arbitrator(s) is/are appointed by the parties or by the Court of law unless specifically directed by Hon'ble Court otherwise on the matter, and shall be shared equally by the Employer and the Contractor. However, the expenses incurred by each party in connection with the preparation, presentation will be borne by itself.

21. Jurisdiction of Courts The Contract Agreement shall be subject to exclusive jurisdiction of Courts as indicated in the Contract Data.

22. Risk Allocation and mitigation measures Various Risk events anticipated, potential impact of such events, risk allocation and mitigation measures have been identified and tabulated as Annexure 5 of Particular Conditions of Contract.

APPENDIX 1

SALIENT FEATURES OF SOME MAJOR LABOUR LAWS APPLICABLE TO ESTABLISHMENTS ENGAGED IN BUILDING AND OTHER CONSTRUCTION WORK

(The laws as current on the date of bid opening will apply)

a) **Workmen Compensation Act 1923**: The Act provides for compensation in case of injury by accident arising out of and during the course of employment.

b) **Payment of Gratuity Act 1972**: Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years service or more or on death the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees.

c) **Employees P.F. and Miscellaneous Provision Act 1952 (since amended):** The Act Provides for monthly contributions by the employer plus workers @ 10% or 8.33%. The benefits payable under the Act are:

(i) Pension or family pension on retirement or death, as the case may be.
(ii) Deposit linked insurance on the death in harness of the worker.
(iii) payment of P.F. accumulation on retirement/death etc.

d) **Maternity Benefit Act 1951**: The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc.

e) **Contract Labour (Regulation & Abolition) Act 1970**: The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by Law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour.

f) **Minimum Wages Act 1948**: The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments.

g) **Payment of Wages Act 1936:** It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers.

h) **Equal Remuneration Act 1979**: The Act provides for payment of equal wages for work of equal nature to Male and Female workers and for not making discrimination against Female employees in the matters of transfers, training and promotions etc.

i) **Payment of Bonus Act 1965**: The Act is applicable to all establishments employing 20 or more employees. The Act provides for payments of annual bonus subject to a minimum of 8.33% of wages and maximum of 20% of wages to employees drawing Rs.3500/-per month or less. The bonus to be paid to employees getting Rs.2500/- per month or above upto Rs.3500/- per month shall be worked out by taking wages as Rs.2500/-per month only. The Act does not apply to certain establishments. The newly set-up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of this Act.

j) **Industrial Disputes Act 1947**: The Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.

k) **Industrial Employment (Standing Orders) Act 1946**: It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to 50). The Act provides for laying down rules governing the conditions of employment by the Employer on matters provided in the Act and get the same certified by the designated Authority.

l) **Trade Unions Act 1926:** The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities.

m) **Child Labour (Prohibition & Regulation) Act 1986**:The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in Building and Construction Industry.

n) **Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979:** The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home upto the establishment and back, etc.

o) **The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996 and the Cess Act of 1996:** All the establishments who carry on any building or other construction work and employs 10 or more workers are covered under this Act. All such establishments are required to pay cess at the rate not exceeding 2% of the cost of construction as may be modified by the Government. The Employer of the establishment is required to provide safety measures at the Building or construction work and other welfare measures, such as Canteens, First-Aid facilities, Ambulance, Housing accommodations for workers near the work

place etc. The Employer to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the Government.

As per Central Government's Notification No.S.O.2899 dated 26.09.1996 under this act, the cess shall be levied @1% of cost of construction works which shall be deducted from each bill of the payment due to the contractor.

p) **Factories Act 1948**: The Act lays down the procedure for approval at plans before setting up a factory, health and safety provisions, welfare provisions, working hours, annual earned leave and rendering information regarding accidents or dangerous occurrences to designated authorities. It is applicable to premises employing 10 persons or more with aid of power or 20 or more persons without the aid of power engaged in manufacturing process.

q) **The Employees State Insurance Act, 1948 (Act No. 34 of 1948) (Provisions as extended from time to time):**An Act to provide for certain benefits to employees in case of sickness, maternity and 'employment injury' and to make provision for certain other matters in relation thereto.

Section 7

Special Conditions of Contract

Section 7

Special Conditions of Contract

Part A: Contract Data

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Section 7 - Special Conditions of Contract

The following Special Conditions of Contract (SCC) shall supplement the General Conditions of Contract (GCC). Whenever there is a conflict, the provisions herein shall prevail over those in the GCC

Part A - Contract Data

Conditions	Reference to GCC	Data
Contract Type	-	S&T Contract
Employer's name and address	1.1.2.2 & 1.3	Haryana Orbital Rail Corporation Limited (HORCL), Plot No 143, 5th Floor, Railtel Tower, Sector-44, Gurugram, Haryana-122003 E-mail: gmphridc@gmail.com
Employer's Representative	1.1.2.6	Chief Project Manager, Haryana Rail Infrastructure Development Corporation Limited (HRIDC), Plot No 143, 5th Floor, Railtel Tower, Sector-44, Gurugram, Haryana-122003 E-mail: gmphridc@gmail.com
Engineer's name and address	1.1.2.4 & 1.3 (b)	RITES Limited in Consortium with SMEC International Pty Ltd, 4th Floor, Plot No.144, RITES Limited, Sector-44, Gurugram, Haryana-122003
Defects Notification Period	1.1.3.7	365 days
Sections	1.1.5.6; 1.1.3.3 & 8.2	**NIL**
Electronic transmission systems	1.3 (a)	By Email
Address for Communication to Employer	1.3 (b)	Plot No 143, 5th Floor, Railtel Tower, Sector-44, Gurugram, Haryana-122003 E-mail: gmphridc@gmail.com
Governing Law	1.4	The Laws of Republic of India
Ruling language	1.4	English
Language for communications	1.4	English
Time for access to Site	2.1	On the Commencement Date.
Performance Security	4.2 & 11.9	The Performance Security shall be for an amount of 3% (Three percent) of the Accepted Contract

Conditions	Reference to GCC	Data
		Amount excluding GST and in the same currency(ies) of the Accepted Contract amount in the prescribed form for the stated amount valid for a period of 28 days beyond issue of performance certificate.
Performance Security	4.2	Rate of addition or Reduction of Performance Security due to variation in contract price: 3%
Normal working hours	6.5	Sunrise to Sunset (This may be modified to suit the work requirements).
Commencement of works	8.1	Within forty two (42) days from the date Contractor receives Letter of acceptance.
Delay damages for the Works when delay is fully attributable to the contractor	8.7(a)	(i) 1/25000 of the Contract Price per day in the currencies and proportions in which the Contract Price is payable in case of delay in completion for entire works; (ii) 1/25000 of the proportionate Contract Price per day in the currencies and proportions in which the Contract Price is payable in case delay in completion of a particular section (Proportionate Contract Price shall be arrived based on total value of Work minus work completed.
Delay damages for the Works when delay is partly attributable to the contractor	8.7(b)	1/500000 to 1/50000 of contract price per day of delay in the currencies and proportions in which the Contract Price is payable.
Maximum amount of delay damages	8.7	5% (five percent) of the Contract Price.
Amount of bonus for early completion	8.13	Not Applicable
Adjustment for Changes in Cost	13.8	Not Applicable
Mobilization advance payment	14.2.1	Not Applicable
Advance Payment against Plant and Machinery	14.2.2	Not Applicable
Interest on Advance Payment	14.2.1 & 14.2.2	Not Applicable
Repayment rate of Advance payment	14.2.4	Not Applicable
Percentage of Retention Money	14.3(c)	Retention money shall be deducted @ 6%

Conditions	Reference to GCC	Data
Limit of Retention Money	14.3 (c)	5% of the Contract Price
Plant and Materials intended for the Works	14.5 (b) (i)	Not applicable
	14.5(c) (i)	Plant and material when delivered are listed in Bill No. 1, 2 ,3 and 4 of BoQ.
Employers' Bank details for LC	14.7.1	Not Applicable
Interest Rate	14.8	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 01year prevailing on the due date plus three percent.
Maximum Total Liability of the Contractor	17.6	Accepted Contract Amount
Periods for submission of insurance: a) evidence of insurance b) relevant policies	18.1	a) 14 days b) 28 days
Maximum amount of deductibles for insurance of Employer's risks.	18.2 (d)	NIL
Minimum amount of insurance by the Contractor for Works and Contractor's Plant and Materials including loss or damage to equipment.	18.2	100 (hundred) percent of Contract price
Minimum amount of insurance by the Contractor for Third party insurance including damage to Other Property and personal injury or death insurance for: a) for other people, and b) for Contractor's Employees.	18.3	Rs.2 (two) crores per occurrence without any limit for number of occurrences.
Jurisdiction of Courts	21	Gurugram, Haryana

Section 7

Special Conditions of Contract

Part B: Specific Provisions

SECTION – 7
PART B

SPECIAL CONDITIONS OF CONTRACT

Whenever there is a conflict or inconsistency between the provisions of the Special Conditions of Contract–Section 7 PART B and the General Conditions of Contract–Section 6, the provisions stipulated in Special Conditions of Contract–Section 7 PART B shall prevail and supersede those appearing in the General Conditions of Contract–Section 6.

Section 7 – PART B - Special Conditions of Contract

The following Special Conditions of Contract (SCC) Section 7-Part B shall supplement the General Conditions of Contract (GCC) Section 6. Whenever there is a conflict, the provisions herein shall prevail over those in the GCC Section 6.

Table of Clauses

Reference to Sub Clause	Subject	Page No.	Remarks
4.8	Annexure 1 – Safety Provisions	4	Amended
14.7.1	Replace entire Sub-Clause 14.7.1 with the following: **Payment Terms** **A) Bill No. 1, 2 & 4: Supply of equipment & material:** i) 70% of payment for items shall be made to the Contractor on receipt of: a) Bill/ Tax invoice b) Receipt of material at site/ Employer's project depot managed by the Contractor c) Insurance of material for the project execution period d) Inspection certificate from the competent inspecting authority e) Delivery Challan f) Certificate from the Contractor & OEM that material being supplied is new with latest version and complies with the Specification g) Commitment from OEM for support to the Contractor/ HORCL/ Railway for the product being supplied and minimum for 7 years. ii) 20% payment shall be made on installation & commissioning of equipment/ material at site iii) 10% payment shall be made on commissioning of complete work & issue of Taking Over Certificate. **B) Bill No. 3, 5: Installation & Commissioning:**		Amended

Reference to Sub Clause	Subject	Page No.	Remarks
	i) 90% payment shall be made on execution/ installation & commissioning of item at site. ii) 10% of payment shall be made on commissioning of complete work & issue of Taking Over Certificate.		
22	Annexure 2 - Risk allocation and Mitigation	18	

Annexure 1 to Section 7

Safety Provisions

(1) The Contractor shall comply with all the precautions as required for the safety of the workmen by the I.L.O Convention No.62 as far as they are applicable to the Contract. The Contractor shall provide all necessary safety appliances; such as safety goggles, helmets, masks, etc to the workmen and the staff.

(2) Suitable scaffolds shall be provided for workmen for all work that cannot safely be done from the ground, or from solid construction except for such short period work as can be done safely from ladders. When a ladder is used, an extra labourer shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, suitable foot-holds and hand-holds shall be provided on the ladder, which shall be given an inclination not steeper than 1/4 to 1 (1/4 horizontal in 1 vertical)

(3) Scaffolding or staging more than 3.25 metres above the ground or floor, swung or suspended from an overhead support or erected with stationary support, shall have a guard rail properly attached, bolted, braced and otherwise secured at least 1 metre high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as maybe necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying in from the support or structure.

(4) Working platforms, gangways and stairways shall be so constructed that they do not sag unduly or unequally, and if the height of any platform or gangway or stairway is more than 3.25 metres above ground level or floor level, it shall have closely spaced boards, have adequate width and be suitably provided with guard rails as described in (3) above.

(5) Every opening in the floor of a structure or in a working platform shall be provided with suitable means to prevent fall of persons or materials by providing suitable fencing or railing with a minimum height of one metre.

(6) Safe means of access and egress shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 metres in length. The width between side rails in a rung ladder shall in no case be less than 30 cm for ladders up to and including 3 metres in length. For longer ladders the width shall be increased at least 6 mm for each additional 30 cm of length. Spacing of steps shall be uniform and shall not exceed 30 cm.

(7) Adequate precautions shall be taken to prevent danger from electrical equipment. Adequate safety measures shall be taken when any work is undertaken near any live highly charged electric wire. Necessary shutdown may be arranged, where and whenever essential. All rules in force in this connection shall be fully complied with. The Contractor shall ensure all precautions to prevent any accidents due to electrocution or otherwise.

(8) No materials on any of the sites shall be so stacked or placed as to cause danger or inconvenience to any person or the public. The Contractor shall provide all necessary fencing and lights to protect the public from accidents and shall be bound to bear the expenses of defending every suit, action or other proceedings at law that

may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and costs which may be awarded in any such suit, action or proceedings to any such person or which may with the consent of the Contractor be paid to compromise any claim by any such person.

(9) Excavation and Trenching : All trenches, 1.5 metres or more in depth, shall at all times be supplied with at least one ladder for each 20 metres in length or fraction thereof, Ladders shall be extended from the bottom of the trench to at least 1 metre above the surface of the ground. The sides of a trench, which is 1.5 metres or more in depth shall be stepped back to provide a suitable slope, or be securely held by timber bracing so as to avoid the danger of side collapse. Excavated material shall not be placed within 1.5 metres of the edge of any trench or half the depth of the trench, whichever is more. Excavation shall be made from the top to the bottom. Under no circumstances shall undermining or undercutting be done.

(10) Demolition : Before any demolition work is commenced and also during the process of the work :

(a) All roads and open areas adjacent to the work site shall either be closed or suitably protected.

(b) No electric cable or apparatus, which is liable to be a source of danger other than a cable or apparatus used by operators, shall remain electrically charged:

(c) All practical steps shall be taken to prevent danger to persons employed by the Employer, from risk of fire or explosion, or flooding. No floor, roof or other part of a building shall be so overloaded with debris or materials as to render it unsafe.

(11) All necessary personal safety equipment as considered adequate by the Engineer shall be available for use of persons employed on the site and maintained in a condition suitable for immediate use; and the Contractor shall take adequate steps to ensure proper use of such equipment by those concerned.

(a) Workers employed on mixing asphaltic materials, cement, lime mortars, concrete etc. shall be provided with protective footwear and protective goggles.

(b) Those engaged in handling any material, which is injurious to the eyes, shall be provided with protective goggles.

(c) Those engaged in welding works shall be provided with welder's protective eye-shield.

(d) Stone breakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.

(e) When workers are employed in sewers and manhole, which are in use, the contractor shall ensure that manhole covers are open and manholes are ventilated at least for an hour before workers are allowed to go into them.

Manholes so open shall be cordoned off with suitable railing and provide warning signals or boards to prevent accidents to the public.

(12) The Contractor shall not employ men below the age of 18 years and women, on the work of painting with products containing lead in any form. Whenever men above the age of 18 years are employed on the work of lead painting, the following precautions shall be taken:

(a) No paint containing lead or lead products shall be used except in the form of paste or ready made paint.

(b) Suitable face masks shall be supplied for use by workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.

(c) Overalls shall be supplied by the Contractor to workmen and adequate facilities shall be provided to enable workers to wash during and at the close of any day's work.

13) When work is performed near any place where there is risk of drowning all necessary equipment shall be provided and kept ready for use and all necessary steps taken for prompt first aid treatment of all injuries likely to be sustained during the course of the work.

(14) Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following:

(a) (i) These shall be of good mechanical construction, sound material and adequate strength and free from patent defects and shall be kept in good working order, be regularly inspected and properly maintained.

(ii) Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength, and free from defects

(b) Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 shall be in charge of any hoisting machine including scaffold equipment. Only trained men over the age of 21 shall be permitted to give signals to such plant and appliance operators.

(c) For every hoisting machine and every chain hook, shackle, swivel and pulley block used in hoisting, lowering or as means of suspension, safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be plainly marked with safe working load. In case of a hoisting machine or a variable safe working load, each safe working load and conditions under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to in the paragraph above shall be loaded beyond safe working load except for the purpose of testing.

(d) In case of the Employer's machine, safe working load shall be notified by the Engineer or his Representative. As regards Contractor's machines, the Contractor shall notify safe working load of each machine to the Engineer or

his Representative, whenever he brings it to the site of work and get it verified by him.

(15) Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances shall be provided with efficient safeguards; hoisting appliances shall be provided with such means as will reduce the risk of accident during descent of load to the minimum. Adequate precautions shall be taken to reduce to the minimum risk of any part of a suspended load becoming accidentally displaced. When workers are employed on electrical installations, which are already energised, insulating mats, working apparel such as gloves, sleeves and boots, as may be necessary, shall be provided. Workers shall not wear any rings, watches and carry keys or other materials which are good conductor of electricity.

(16) All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in a safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities shall be provided at or near places of work.

(17) These safety provisions shall be brought to the notice of all concerned by displaying on a notice board at a prominent place at the work location. Persons responsible for ensuring compliance with the Safety Code shall be named therein by the Contractor.

(18) To ensure effective enforcement of the rules and regulations relating to safety precautions, arrangements made by the contractor shall be open to inspection by the Engineer or his Representative.

(19) Notwithstanding anything contained in conditions (1) to (17) above, the Contractor shall at its own costs, remain liable to comply with the provisions of all acts, rules, regulations, and bylaws for the time being in force in India and applicable in this matter.

(20) For work carried out in the vicinity of any wharf or quay, the Contractor shall abide by all the provisions of the Dock Workers (Safety, Health and Welfare) Scheme, 1961.

(21) The Contractor shall at his own expense provide protective safety Equipment like gloves and footwear for all labour engaged on concrete mixing work and all other types of working involving the use of tar, cement, etc. to the satisfaction of the Engineer or his Representative, and on his failure to do so, the employer shall be entitled to provide the same and recover the cost from the Contractor.

(22) The Contractor shall be responsible for observance, by the sub-contractors, of the foregoing provisions.

Annexure-2

Event			Risk allocation and Mitigation	
Event No.	**Brief Description**	**Potential Impact**	**Employer**	**Contractor**
1	Delayed handing over of Site	Delay in commencement of works and delay in progress	Employer to Prioritize handover of Site in accordance with Contract conditions and agreed work's programme. Employer is responsible if any delay affects activities according to agreed work's program. In such case the Employer shall: (i) grant EOT (ii) Cost of Idling of resources till the contractor is asked to de-mobilize the resources. (iii)New rate as per GCC Clause 12.3.1 (c)	(i) Contractor is responsible if Timely Notice is not given. (ii) Cost of Idling of resources will be borne by the contractor after 15 days from the date of issue of notice by the Employer/Engineer for de-mobilization of the resources.
2	Delayed handover of Good for Construction (GFC) drawings	Delay in commencement of works and delay in progress	Employer to provide GFC in accordance with Contract conditions and agreed work's programme. Employer is responsible if any delay affects activities according to agreed work's program. In such case the Employer shall: (i) grant EOT (ii) Cost of Idling of resources till the contractor is asked to de-mobilize the resources.	(i) Contractor is responsible if Timely Notice is not given. (ii) Cost of Idling of resources will be borne by the contractor after 15 days from the date of issue of notice by the Employer/Engineer for de-mobilization of the resources.
3	Inaccuracy in survey data.	Wrong execution without intimation for revision of drawings.	The Employer is responsible to provide necessary clarification and modified GFC if required, commensurating with the agreed works program. In case of delay in providing the revised/modified GFC which affects the activities	1. Checking of survey and established permanent benchmarks by the contractor immediately after award of work. 2. Contractor is responsible to give timely notice in case any inaccuracy in survey data is observed, in

Event			Risk allocation and Mitigation	
Event No.	**Brief Description**	**Potential Impact**	**Employer**	**Contractor**
			according to agreed work's program, the Employer shall consider EOT.	accordance with GCC Clause 4.7. Failure to give notice in specified time shall not entitle the Contractor for any claim including EOT.
4	Mis-match in tender drawings, BOQ, Technical Specifications, survey data etc	Variation in quantities	The Employer is responsible to provide necessary clarification and revision, if any, after the Contractor has notified the required changes.	1. The Contractor shall be responsible: (i) to ensure corelation in various drawings, BOQ and Specifications , (ii) to timely notify the discrepancies, if any and (iii) to submit the variation statement if any as per contractual Provisions. 2.If Timely Notice as per GCC cl 1.9 is not given, the Contractor shall be responsible for any consequences arising out of the above.
5	Inadequate initial cashflow of Contractor	1. Delay in initial mobilization of resources - Machines, Manpower and materials. 2. Delay in execution of Activities. 3. Delay in placement of PO for critical materials and equipments.	1. The Employer to ensure timely payment of advances as per the Contract Conditions, after submission of valid documents in the acceptable formats, as agreed and sought by the contractor 2. Delay in payment of advances will be dealt with under GCC clause 14.8 (related to delayed payment)	1. The Contractor to Demonstrate adequate cash flows in the program to be submitted as per GCC Clause 8.3 2. Raise demands of advances in a timely manner to Employer, alongwith valid documents in acceptable form. 3. In case of non utilization of advances for mobilization, Employer will be entitled to seek return of unused advance.
6	Delay in arrangement	Delay in start and Progress of	Wherever required, the employer will provide	The Contractor Shall ensure to:

Event			Risk allocation and Mitigation	
Event No.	**Brief Description**	**Potential Impact**	**Employer**	**Contractor**
	of land for own use, construction power, Permissions for Mining, Storage of explosives, blasting, Pollution control certificates, Batching plant etc. by Contractor	work at site.	assistance to contractor strictly in the form of writing supportive letters to the concerned authorities as requested by the contractor.	1. Plan site layout as per demarcated land for works. 2. Timely Hire/Lease additional land if required. 3. Timely application for various permissions from the concerned authorities. 4. Timely approvals/ Permissions
7	Exceptionally Heavy rain or adverse climatic conditions affecting works	(1) Non-working conditions leading to delay in construction activities. (2) Blockage of Access routes. (3) Idling of men and machinery	Extension of time only under GCC 8.4(c), if the rain or adverse climatic conditions are beyond monsoon period as described in section 5 and the programmed works at site are affected .	(1) Providing arrangement of drainage at work sites to resume the activities. (2) Adequate and suitable machineries for restoration. (3) Provision of battery backup/search light at work sites. (4) Paying attention to local weather warnings.
8	Adverse environmental conditions leading to stoppage of construction activity by Statutory Bodies	(1)Stoppage of work leading to delay in completion of project. (2) Idling of resources	Extension of time only under GCC 8.4(c). If stoppage of work extends for a continuous period of 7 days or more, due to the directives of any statutory body, idling charges of plant and machinery will be considered for such stretch of period.	
9	Dust Pollution in Work areas, Access roads and Dumping	(1) Non-working conditions leading to delay in construction.	Wherever required, the employer will provide assistance to contractor in the form of writing supportive letters to the concerned	The Contractor must ensure compliance of all regulations and applicable laws in connection with this in addition to some of

Event			Risk allocation and Mitigation	
Event No.	**Brief Description**	**Potential Impact**	**Employer**	**Contractor**
	sites and/or cause a permanent damage on the environment including possible land, water or air pollution and damage to flora and fauna	(2) Frequent breakdowns and increasing maintenance requirements of machineries. (3) Deteriorating Health of manpower. (4) Stoppage of work by government authorities because of non compliance of norms by the contractor.	authorities.	the measures mentioned below: (1) Regular sprinkling of water in work areas and on access roads. (2) Sprinkling of water on spoil before transportation and cover spoil on dumper trucks by tarpaulin before leaving site. (3) Installation of dust isolation devices in batching plant and raw material stock yards. (4) Isolation of areas causing pollution. (5) Regular Health checkup of manpower. (6) Regular maintenance of Machineries.
10	Health and safety of workers including personal injury resulting in the extreme loss of life	Closure of site / stoppage of work		The Contractor shall: (i) follow the safety rules during construction. (ii) have effective management of work sites. (iii) conduct regular counselling, mock drills and safety audits. (iv) Provide Insurance of Contractor's Personnel as per Cl 18.4 of GCC
11	Occurrence of Seismic events	(1) Non-working conditions leading to delay in construction. (2) Damage to temporary and permanent installations.	The Employer will provide required Time extension	Seek adequate coverage of damage through insurances.

Event			Risk allocation and Mitigation	
Event No.	**Brief Description**	**Potential Impact**	**Employer**	**Contractor**
12	Banning of source of construction materials due to notification by statutory bodies	(1) Hindrance to progress of work. (2) Change in source of material leading to Variation in cost.	1.In case of non availability of materials due to some Government notifications such as banning of mining activities etc, Extension of time will be given under cl 8.4 (d) of GCC. 2. Differential rates will be worked out in case the procurement cost of such construction material varies by more than 10%, due to change in source of construction material as a result of banning of source by the statutory body.	Contractor is solely responsible for arranging construction Material and timely action such as: (1) Identification of alternate source of material to cater to any eventuality. (2) Timely replenishment of material reserves. (3) Obtaining approvals for multiple sources in advance.
13	Safety of Running track and Road traffic at Level Crossings	Can result in accidents of Train and Road traffic	The Employer shall provide assistance in obtaining safety certificate from Railway.	1. Provide proper Fencing and maintain the same in good condition 2. Provide lookout persons to avoid infringements to the running Tracks 3. Get safety certificates issued for competence of personnel as per IRPWM para 4.26
14	Delay in finalization of new items/ Variations	Delay in cash flow of Contractor	1.In case of delay in approval of new rates, the Employer shall pay interest on the differential payment between sanctioned rate minus provisional payment made 2. Timely analysis and recommendations by PMC 3. Timely finalization by RVNL	1.Submission of proposal for new rate by contractor with all supporting documents. 2. Timely notice to Engineer

Section 8

Contract Forms

Section 8 - Contract Forms

This Section contains forms which, once completed, will form part of the Contract. The forms for Performance Security and Advance Payment Security, when required, shall only be completed by the successful Bidder after contract award.

All italicized text is for guidance how to prepare the various forms and shall be deleted from the final documents.

Table of Forms

FORM No. COF/1

Letter of Acceptance

[on letterhead paper of the Employer]

. . . . . date. . . . . .

To: . ...*[name and address of the Contractor]* . . . . . .

Subject:. . . . . [*Insert Name and Identification number]……..[Notification of Award]…..*

This is to notify you that your Bid dated . . . *[Insert Date]*. . . for execution of the *. . . [name of the contract and identification number, as given in the Contract Data] . . .* for the Accepted Contract Amount of the equivalent of INR *. . . [Insert amount in numbers and words and name of the currency]. .* , as corrected and modified in accordance with the Instructions to Bidders, is hereby accepted.

You are requested to furnish the Performance Security within 28 days in accordance with the Conditions of Contract, using for that purpose the *of* the Performance Security Form No. COF/3 included in Section 8 (Contract Forms) of the Bidding Document.

Authorized Signature:
.....

Name and Title of Signatory:
.....

FORM No. COF/2

Contract Agreement

THIS AGREEMENT made the . . . . . .day of . . . ., between . . . . . [N*ame of the Employer. . .*. . . . . (hereinafter "the Employer"), of the one part, and . . . . . [*name of the Contractor**]. . [1]. . .***(hereinafter "the Contractor"), of the other part:

WHEREAS the *Employer* desires that the Works known as . . . . . [*name of the Contract**]. . . . .***should be executed by the Contractor, and has accepted a Bid by the Contractor for the execution and completion of these Works and the remedying of any defects therein,

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.

   - the Letter of Acceptance
   - the Letter of Technical Bid
   - the Letter of Price Bid
   - the Addenda Nos. . . . . [***insert addenda numbers if any]****. . . . .*
   - the Special Conditions of Contract

     Part A : Contract Data

     Part B : Specific Provisions
   - the General Conditions of Contract;
   - the Specification
   - the Drawings*;*
   - the Work's Requirements
   - the completed Schedules including (priced Bill of Quantities)
   - Any other documents

3. In consideration of the payments to be made by the Employer to the Contractor as indicated 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

[1] *In case Contractor is a Joint Venture the 'name of the contractor' shall be inserted as under : "the Joint Venture under the name and title of ……, comprising of ….[Lead Partner] ;……..; and ….."*

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 . . . . . [*name of the borrowing country*]. . . . . on the day, month and year indicated above.

Signed by	Signed by
for and on behalf of the Employer in the presence of	for and on behalf the Contractor in the presence of
Witness, Name, Signature, Address, Date	Witness, Name, Signature, Address, Date

COF/3

FORM OF CONTRACTPERFORMANCE SECURITY
(BANK GUARANTEE)

[Refer Clause 41 of Instructions to Bidders]

(On non-judicial stamp paper of the appropriate value in accordance with stamp Act. The stamp paper to be in the name of Executing Bank).

From:

Name and Address of the Bank…..

……..

To:

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

WHEREAS, Haryana Orbital Rail Corporation Limited, hereinafter called the Employer, acting through ***[Insert Designation and address of the Employer's Representative]***, has accepted the bid of ***[Insert Name and address of the Contractor]***, hereinafter called the Contractor, for the work of [Insert Name of Work], vide Notification of Award No.***[Insert Notification of Award No.]***.

AND

WHEREAS, the contractor is required to furnish Performance Security for the sum of ***[Insert Value of Performance Security required]***, in the form of bank guarantee, being a condition precedent to the signing of the contract agreement.

WHEREAS, ***[Insert Name of the Bank]***, with its Branch ***[Address]*** having its Headquarters office at ***[Address]***, hereinafter called the Bank, acting through ***[Designation(s) of the authorised person of the Bank]***, have, at the request of the ***[Insert name of the JV partner]***, a JV partner on behalf of the contractor, agreed to give guarantee for performance security and additional performance security as hereinafter contained:

1. KNOW ALL MEN by these present that I/We the undersigned ***[Insert name(s) of authorized representatives of the Bank]***, being fully authorized to sign and incur obligations for and on behalf of the Bank, confirm that the Bank, hereby, unconditionally and irrevocably guarantee

to pay the Employer the full amount in the sum of [Insert Value of Performance Security required] as above stated.

2. The Bank undertakes to immediately pay on presentation of demand by the Employer any amount up to and including aforementioned full amount without any demur, reservation or recourse. Any such demand made by the Employer on the Bank shall be final, conclusive and binding, absolute and unequivocal notwithstanding any disputes raised/ pending before any Court, Tribunal, Arbitration or any Authority or any threatened litigation by the Employer of Bank.

3. On payment of any amount less than aforementioned full amount, as per demand of the Employer, the guarantee shall remain valid for the balance amount i.e. the aforementioned full amount less the payment made to the Employer.

4. The Bank shall pay the amount as demanded immediately on presentation of the demand by Employer without any reference to the contractor and without the Employer being required to show grounds or give reasons for its demand or the amount demanded.

5. The Bank Guarantee shall be unconditional and irrevocable.

6. The guarantee hereinbefore shall not be affected by any change in the constitution of the Bank or in the constitution of the Contractor.

7. The Bank agrees that no change, addition, modifications to the terms of the Contract Agreement or to any documents, which have been or may be made between the Employer and the Contractor, will in any way release us from the liability under this guarantee; and the Bank, hereby, waives any requirement for notice of any such change, addition or modification to the Bank.

8. This guarantee is valid and effective from the date of its issue, which is ***[insert date of issue]***. The guarantee and our obligations under it will expire on ***[Insert the date twenty eight days after the expected end of defect liability period]***. All demands for payment under the guarantee must be received by us on or before that date.

9. The Bank agrees that the Employers right to demand payment of aforementioned full amount in one instance or demand payments in parts totalling up to the aforementioned full amount in several instances will be valid until either the aforementioned full amount is paid to the Employer or the guarantee is released by Employer before the Expiry date.

10. The Bank agrees that its obligation to pay any amount demanded by the Employer before the expiry of this guarantee will continue until the amount demanded has been paid in full.

11. The expressions Bank and Employer herein before used shall include their respective successors and assigns.

12. The Bank hereby undertakes not to revoke the guarantee during its currency, except with the previous consent in writing of the employer. This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG), ICC Publication No. 758.

13. The Guarantee shall be in addition to and without prejudice to any other security Guarantee (s) of the contractor in favour of the Employer available with the Employer. The Bank, under this Guarantee, shall be deemed as Principal Debtor of the Employer.

Date ……

Place…… [Signature of Authorised person of Bank]

……
[Name in Block letters]
……
[Designation]
……
[P/Attorney] No.
……
Bank's Seal

[P/Attorney] No.……

Witness:

1. *Signature*
   Name & Address & Seal

2. *Signature*
   Name & address & Seal

Note:

1. All italicized text is for guidance on how to prepare this bank guarantee and shall be deleted from the final document.

2. In case the guarantee is issued by a foreign Bank, which does not have operations in India, the said bank shall have to provide a counter-guarantee by State Bank of India.

3. In case the Contractor is a JV, the Performance Security is required to be furnished on behalf of the JV in favour of the Employer by the JV Partners in proportion of their respective percentage share specified in the JV Agreement. The percentage share of M/s ***[Insert Name of the JV Partner]*** in the JV is ***[Fill share % in the JV]*** percent. All the Bank Guarantee of JV Partners are liable to be encashed cumulatively.

FORM OF ADDITIONAL PERFORMANCE SECURITY
(BANK GUARANTEE)

[Refer Clause 35.5 of Instructions to Bidders]

(On non-judicial stamp paper of the appropriate value in accordance with stamp Act. The stamp paper to be in the name of Executing Bank)

From:

Name and Address of the Bank…..
……..

To:

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

WHEREAS, Haryana Orbital Rail Corporation Limited, hereinafter called the Employer, acting through ***[Insert Designation and address of the Employer's Representative]***, has accepted the bid of ***[Insert Name and address of the Contractor]***, hereinafter called the Contractor, for the work of [Insert Name of Work], vide Notification of Award No.***[Insert Notification of Award No.]***.

AND

WHEREAS, the contractor is required to furnish additional Performance Security for the sum of ***[Insert Value of additional Performance Security required]***, in the form of bank guarantee, being a condition precedent to the signing of the contract agreement.

WHEREAS, [Insert Name of the Bank], with its Branch ***[Address]*** having its Headquarters office at ***[Address]***, hereinafter called the Bank, acting through ***[Designation(s) of the authorised person of the Bank]***, have, at the request of the ***[Insert name of the JV partner]***, a JV partner on behalf of the contractor, agreed to give guarantee for additional performance security as hereinafter contained:

1. KNOW ALL MEN by these present that I/We the undersigned ***[Insert name(s) of authorized representatives of the Bank]***,being fully authorized to sign and incur obligations for and on behalf of the Bank, confirm that the Bank, hereby, unconditionally and irrevocably guarantee to pay the Employer the full amount in the sum of ***[Insert Value of additional Performance Security required]***as above stated.

2. The Bank undertakes to immediately pay on presentation of demand by the Employer any amount up to and including aforementioned full amount without any demur, reservation or recourse. Any such demand made by

the Employer on the Bank shall be final, conclusive and binding, absolute and unequivocal notwithstanding any disputes raised/ pending before any Court, Tribunal, Arbitration or any Authority or any threatened litigation by the Employer of Bank.

3. On payment of any amount less than aforementioned full amount, as per demand of the Employer, the guarantee shall remain valid for the balance amount i.e. the aforementioned full amount less the payment made to the Employer.

4. The Bank shall pay the amount as demanded immediately on presentation of the demand by Employer without any reference to the contractor and without the Employer being required to show grounds or give reasons for its demand or the amount demanded.

5. The Bank Guarantee shall be unconditional and irrevocable.

6. The guarantee hereinbefore shall not be affected by any change in the constitution of the Bank or in the constitution of the Contractor.

7. The Bank agrees that no change, addition, modifications to the terms of the Contract Agreement or to any documents, which have been or may be made between the Employer and the Contractor, will in any way release us from the liability under this guarantee; and the Bank, hereby, waives any requirement for notice of any such change, addition or modification to the Bank.

8. This guarantee is valid and effective from the date of its issue, which is [insert date of issue]. The guarantee and our obligations under it will expire on ***[Insert the date twenty eight days after the expected end of defect liability period]***. All demands for payment under the guarantee must be received by us on or before that date.

9. The Bank agrees that the Employers right to demand payment of aforementioned full amount in one instance or demand payments in parts totalling up to the aforementioned full amount in several instances will be valid until either the aforementioned full amount is paid to the Employer or the guarantee is released by Employer before the Expiry date.

10. The Bank agrees that its obligation to pay any amount demanded by the Employer before the expiry of this guarantee will continue until the amount demanded has been paid in full.

11. The expressions Bank and Employer herein before used shall include their respective successors and assigns.

12. The Bank hereby undertakes not to revoke the guarantee during its currency, except with the previous consent in writing of the employer. This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 758.

13. The Guarantee shall be in addition to and without prejudice to any other security Guarantee(s) of the contractor in favour of the Employer available with the Employer. The Bank, under this Guarantee, shall be deemed as Principal Debtor of the Employer.

Date ……

Place……. [Signature of Authorised person of Bank]

…….
[Name in Block letters]
…….
[Designation]
…….
[P/Attorney] No.
…….
Bank's Seal

[P/Attorney] No.……

Witness:

1. *Signature*
   Name & Address & Seal

2. *Signature*
   Name & address & Seal

Note:

1. All italicized text is for guidance on how to prepare this bank guarantee and shall be deleted from the final document.

2. In case the guarantee is issued by a foreign Bank, which does not have operations in India, the said bank shall have to provide a counter-guarantee by State Bank of India.

3. The Bank Guarantee should be duly attested by Notary public with notarial stamp of appropriate value affixed thereon.

4. In case the Contractor is a JV, the additional Performance Security is required to be furnished on behalf of the JV in favour of the Employer by the JV Partner(s) who is responsible for execution of schedule(s) (as per JV agreement) against which additional Performance Security is required to be submitted in terms of ITB 35.5. All the Bank Guarantee of JV Partners are liable to be encashed cumulatively.

Advance Payment Security

[Refer Clause 14.2 of GCC]

(On non-judicial stamp paper of appropriate value in accordance with stamp Act. The stamp paper to be in the name of Executing Bank)

From

[Name and Address of the Bank]

To

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

Beneficiary: Haryana Orbital Rail Corporation Limited.

Guarantee No.: *[reference number of the guarantee]* **Dated**: *[……..]*

WHEREAS, Haryana Orbital Corporation Limited **(hereinafter called the Employer)** has entered into Contract No. ***[….reference number of the Contract….]***dated ***[…….]*** for the execution of ***[name of the contract]*****(hereinafter called the Contract)** with***[….name of the Contractor….]*****(hereinafter called the Contractor)**.

WHEREAS, according to the Conditions of the Contract, an advance payment is admissible to the contractor against submission of bank guarantee(s).

At the request of the Contractor, we ***[….name of the Bank….]*** with our branch at***[….address….]***,having our Head Office at ***[….address….]*****(hereinafter called the Bank)** have, at the request of ***[.....Insert name of the JV partner.....]***, a JV partner on behalf of the Contractor, agreed to give the said guarantee as hereinafter contained:

1. KNOW ALL MEN by these present that I/We the undersigned ***[….Insert name(s) of authorized representative(s) of the Bank….]***, being fully authorized to sign and incur obligations for and on behalf of the Bank, confirm that the Bank, hereby, unconditionally and irrevocably guarantees to pay the Employer the sum of Rs.**[….value in figure….]**(Rupees ***[….value in words….]*** only**(hereinafter called the Full Amount)**.

2. The Bank undertakes to immediately pay to the Employer, without any demur, reservation or recourse, any amount up to and including aforementioned full amount upon first written demand/demands from the Employer.

3. On payment of any amount less than aforementioned full amount, as per demand of the Employer, the guarantee shall remain valid for the balance amount i.e. the aforementioned full amount less the payment made to the Employer.

4. The Bank shall pay the amount so demanded without any reference to the contractor and without the Employer being required to show grounds or give reasons for its demand or the amount demanded.

5. The guarantee hereinbefore shall not be affected by any change in the constitution of the Bank, the Contractor or the Employer.

6. The Bank agrees that no change, addition, modification to the terms of the Contract Agreement or to any document, which have been or may be made between the Employer and the Contractor, will in any way release us from the liability under this guarantee; and the Bank, hereby, waives any requirement for notice of any such change, addition or modification to the Bank.

7. This guarantee is valid and effective from the date of it's issue, which is ***[….date of issue….]***. The guarantee and our obligations under it will expire on dated ***[….Please refer note 4 & 5….]***. All demands for payment under the guarantee must be received by us on or before that date.

8. The Bank agrees that the Employer's right to demand payment of aforementioned full amount in one instance or demand payments in parts totalling up to the aforementioned full amount in several instances will continue until either the aforementioned full amount is paid to the Employer or the guarantee validity period expires.

9. The Bank agrees that it's obligation to pay any amount demanded by the Employer before the expiry of this guarantee will continue until the amount demanded has been paid in full.

10. The expressions Bank and Employer herein before used shall include their respective successors and assigns.

11. The Bank hereby undertakes not to revoke the guarantee during its currency, except with the previous consent in writing of the employer. This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 758.

Dated[.....]
Place[.....]

.....
(Signature of the Authorized Person of the Bank)

.....

(Name in Block Letters)

.....
(Designation)

.....
(Bank's Seal)

.....
(Authorization No.)

Witness:

.....
Signature, Name & Address

.....
Signature, Name & Address

Note:

1. All italicized text in brackets [….text….] is for guidance on how to prepare this bank guarantee and shall be deleted from the final document.
2. In case the guarantee is issued by a foreign Bank, the said bank shall have operations in India and should be issued by Indian operations branch of the said bank.
3. The Bank Guarantee should be duly attested by Notary Public with notarial stamps of appropriate value affixed thereon.
4. ***Mobilization Advance under GCC 14.2.1***:

    a. ***For Single Entity***
    For each Instalment of Advance, two Bank Guarantees of equal amounts (each equal to half of the first instalment of advance plus 10%) shall be furnished. Each Bank Guarantee shall be valid for the stipulated completion period of the contract.

    OR

    b. ***For JV***
    For each Instalment of Advance, individual JV partner shall furnish Bank Guarantee equal to his share in the instalment of Advance plus 10%. Each Bank Guarantee shall be valid for the stipulated completion period of the contract.

5. ***Advance against Plant and Machinery under GCC 14.2.2***:

    a. ***For Single Entity***
    For each Instalment of Advance, a Bank Guarantee equal to the Instalment of advance plus 10% shall be furnished. The Bank Guarantee shall be valid for the stipulated completion period of the contract.

    OR

b. For JV

For each Instalment of Advance, individual JV partner shall furnish a Bank Guarantee equal to his share in the instalment of advance plus 10%. Each Bank Guarantee shall be valid for the stipulated completion period of the contract.

INDEMNITY BOND FOR THE SAFE CUSTODY OF THE PLANT AND MATERIALS SUPPLIED BY THE CONTRACTOR

[Refer Clause 14.5 of GCC]

(To be executed on Non-Judicial Stamp Paper of Appropriate Value and notarised)

THIS INDEMNITY BOND made on this _____ day of _____ 20___ by _____(*insert the name of the Contractor and its registered address*) (hereinafter called "the Contractor") which expression shall where the context do admits or implies be deemed to include its executors, administrators and assigns, in favour of the Haryana Orbital Rail Corporation Limited, Plot No 143, 5th Floor, Railtel Tower, Sector-44, Gurugram, Haryana-122003(hereinafter called "Employer"/"HORCL") on the other part.

WHEREAS by an Agreement/Letter of Acceptance No._____dated _____ (hereinafter called "the said agreement"), the Contractor has agreed to execute the _____(*Name of Work*) (hereinafter called "the Works") .

AND WHEREAS the Contractor has submitted to HORCL/ the Engineer for payment on plants &materials procured by him and brought to the site of the Works or his workshop for use in the Works.

AND WHEREAS HORCL/ the Engineer has agreed to make advance/stage payment to the Contractor the total sum of Rs._____ (*in Figures*) [Rupees _____ (*in Words*) in Interim Payment Certificate (IPC) No._____, the quantities and other particulars of which are detailed in this IPC for the said works signed by the Contractor on _____ for the Plant and Materials brought by the Contractor to site of the works or his workshop. Brief details are also mentioned in schedule 1 appended hereto.

NOW THIS INDEMNITY BOND WITNESS that in pursuance of the said agreement and in consideration of the sum of Rs. _____ (*in Figures*) _____ (*in Words*) on or before the execution of these presents to be paid to the Contractor by HORCL so aforesaid, the Contractor doth hereby covenant and agree with HORCL and declare as follows: -

1. That the said sum of Rs. _____ (*In Figures*) _____ (*in Words*) to be paid by HORCL to the Contractor as aforesaid shall be utilized by the Contractor in or towards the execution of the said works and for no other purpose whatsoever.
2. That the Plant and Materials detailed in the said IPC which have been offered to and accepted by HORCL/ the Engineer, are absolutely the Contractor's own property and free from encumbrances of any kind and the Contractor will not make any application for or receive any further payment on the Plant and Materials which are not absolutely his own property and free from encumbrances of any kind, the Contractor indemnifies the HORCL against all claims on any Plant and Materials in respect of which payment is to be made to him as aforesaid.
3. That the Contractor undertakes that the Plant and Materials shall be used exclusively

for the performance / execution of the Contract strictly in accordance with the terms and conditions of the Contract and no part of the Plant and Materials shall be utilized for any other work or purpose whatsoever.

4. That the Contractor is obliged and shall remain absolutely responsible for the safe transit / protection and custody of the Plant and Materials against all risks whatsoever including acts of the God till the Plant and Materials are duly incorporated in the works, commissioned and are taken over by HORCL/Railway (including surplus Plant and Materials, if required as instructed by HORCL/ the Engineer) in accordance with the terms of the Contract. The Contractor undertakes to keep HORCL harmless against any loss or damage that may be caused to the Plant and Materials.

5. That the said Plant and Materials shall not on any account be removed from the site of the works except with the written permission of HORCL/ the Engineer. Further, HORCL/ the Engineer shall always be free at all times to take possession of the materials in whatever form the materials may be in, if in its opinion, the Plant and Materials are likely to be endangered, mis-utilized or converted to uses other than those specified in the Contract, by any acts or omission or commission on the part of the Contractor or any other person or on account of any reason whatsoever and the Contractor binds himself and undertakes to comply with the directions of demand of HORCL to return the Plant and Materials without any demur or reservation.

6. That the said plant and materials shall, at all times, be open to inspection by HORCL/ the Engineer or any authorized representative. In the event of the said material or any part thereof at any time being found to be in lesser quantity than for which payment has been released or the same has been stolen, destroyed or damaged or becoming deteriorated, the Contractor will forthwith replace the same or repair and make good the same as required by HORCL/ the Engineer.

7. That making payment does not mean that Plant and Materials are of required specifications and quality or that whole of the quantity brought to site by Contractor will be used in the work. The Contractor is fully responsible for the materials to conform to required quality and specification and if at any time HORCL/ the Engineer do not find the material satisfactory, the Contractor at his own cost would replace these. HORCL/ the Engineer would be at liberty to recover cost of these from any dues of the Contractor. Also any Plant and Materials which are in excess of what is finally required under the contract would be the Contractor’s property without any liability on HORCL/ the Engineer who would recover the cost of this from the Contractor.

8. That this Indemnity Bond is irrevocable. If at any time, any loss or damage occurs to the Plant and Materials or the same or any part thereof is mis-utilized in any manner whatsoever, then the Contractor hereby agrees that the decision of HORCL/ the Engineer as to assessment of loss or damage to the Plant and Materials shall be

final and binding on the Contractor. The Contractor binds itself and undertakes to replace the lost and/or damaged Plant and Materials at its own cost and/or shall pay the amount of loss to HORCL without any demur, reservation or protest. This is without prejudice to any other right or remedy that may be available to HORCL/ the Engineer against the Contractor under the Contract or under this Indemnity Bond.

9. That if the Contractor shall at any time make any default in the performance or observance in any respect of any of the terms and provisions of the said agreement or of those presents, the total amount of the payment shall immediately on the happening of such default be recovered by HORCL/ the Engineer from any dues of Contractor. It is also clearly understood by the Contractor that non-observance of the obligations under this Indemnity Bond by the Contractor shall inter-alia constitute a criminal breach of trust on the part of the Contractor for all intents and purpose including legal / penal consequences.

10. IN WITNESS WHEREOF, the Contractor has hereunto set its hand through its authorized representative, the day, month and year first above mentioned.

11. SCHEDULE 1

Particulars of the Plant and Materials	**Quantity**	**Value of the Plant and Materials**

Signed, Sealed and Delivered by the said Contractor

(Contractor's Name)

Dated: ……. (AUTHORISED SIGNATORY)

Place: ……. SEAL OF COMPANY

IN THE PRESENCE OF:

WITNESS: SIGNATURE _____

NAME: _____

ADDRESS : _____

Note:

The contractor has the option to submit the Indemnity Bond to cover all the items and quantities of Plant and Materials of stage payment or to submit indemnity bond each time the stage payment is to be taken or Plant and Materials advance is to be taken.

FORM OF BANK GUARANTEE FOR RELEASE OF BALANCE RETENTION MONEY

(On non-judicial stamp paper of the appropriate value in accordance with stamp Act. The stamp paper to be in the name of Executing Bank).

From:

……..
…….*Name and Address of the Bank*…..
……..

To:

Haryana Orbital Rail Corporation Limited,
Plot No 143, 5th Floor, RailTel Tower,
Sector-44, Gurugram,
Haryana-122003.

a) WHEREAS**,** Haryana Orbital Rail Corporation Limited, (hereinafter called the **Employer),** acting through ***[Insert Designation and address of the Employer's Representative]***, has entered into a contract with ***[Insert Name and address of the Contractor's Representative]***,, (hereinafter called the **Contractor),** for the work of ***[Insert Name of Work]***, vide Notification of Award No.***[Insert Notification of Award No.].***

b) WHEREAS as per conditions of contract Employer has deducted an amount of RS____***[Insert Amount deducted as retention money]***towards retention money till date, and WHEREAS now the contractor has requested the Employer for releasing the said amount on submission of a bank guarantee of equivalent amount which has been accepted by the Employer.****

OR

WHEREAS as per conditions of contract Employer has deducted an amount of RS____***[Insert Amount deducted as retention money]***towards retention money till date, out of a total amount of Rs____ [***Insert total Amount of retention money deductable as specified in the contract]***which is due to be deducted as retention money as per Contract agreement and WHEREAS now the Contractor has requested the Employer to accept a bank guarantee of the equivalent amount of the total retention money due as per contract agreement so that the amount already deducted may be released in favour of the contractor and that no further deduction towards retention money will be made in future which has been accepted by the Employer. ****

c) WHEREAS, ***[Insert Name of the Bank]***, with its Branch ***[Address]*** having its Headquarters office at ***[Address]***, hereinafter called the **Bank,** acting through ***[Designation(s) of the authorised person of the Bank]***, have, at the request of the contractor, agreed to give guarantee as hereinafter contained:

1. KNOW ALL MEN by these present that I/We the undersigned ***[Insert name(s) of authorized representatives of the Bank],***being fully authorized to sign and incur obligations for and on behalf of the Bank**,** confirm that the Bank, hereby, unconditionally and irrevocably guarantee the Employer to pay the full amount in the sum of ***[Insert Value of the Bank Guarantee being submitted]*** as above stated.

2. The Bank undertakes to immediately pay to the Employer any amount up to and including aforementioned full amount upon written order/orders from the Employer without any demur, reservation or recourse.

3. On payment of any amount less than aforementioned full amount, as per demand of the Employer, the guarantee shall remain valid for the balance amount i.e. the aforementioned full amount less the payment made to the Employer.

4. The Bank shall pay the amount so demanded without any reference to the contractor and without the Employer being required to show grounds or give reasons for its demand or the amount demanded.

5. The guarantee hereinbefore shall not be affected by any change in the constitution of the Bank or in the constitution of the Contractor.

6. The Bank agrees that no change, addition, modifications to the terms of the Contract Agreement or to any documents, which have been or may be made between the Employer and the Contractor, will in any way release us from the liability under this guarantee; and the Bank, hereby, waives any requirement for notice of any such change, addition or modification to the Bank.

7. This guarantee is valid and effective from the date of it's issue, which is ***[insert date of issue]***. The guarantee and our obligations under it will expire on ***[Insert the date twenty eight days after the expected end of defect liability period.]***. All demands for payment under the guarantee must be received by us on or before that date.

8. The Bank agrees that the Employers right to demand payment of aforementioned full amount in one instance or demand payments in parts totaling up to the aforementioned full amount in several instances will continue until either the aforementioned full amount is paid to the Employer or the guarantee expires.

9. The Bank agrees that it's obligation to pay any amount demanded by the Employer before the expiry of this guarantee will continue until the amount demanded has been paid in full.

10. The expressions Bank and Employer herein before used shall include their respective successors and assigns.

11. The Bank hereby undertakes not to revoke the guarantee during its currency, except with the previous consent in writing of the employer. This guarantee

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

Date …… ……

Place……. [*Signature of Authorised person of Bank]*

[Name in Block letters] ……

[Designation] ……

Address ……..

……

Witness :

1. *Signature*
   Name & Address & Seal
2. *Signature* *Bank's Seal*
   Name & address & Seal *Authorisation No……..*

Note :

1) *All italicized text is for guidance on how to prepare this bank guarantee and shall be deleted from the final document.*
2) *In case the guarantee is issued by a foreign Bank, the said bank shall have operations in India and should be countersigned by Indian operations branch of the said bank.*
3) *The Bank Guarantee should be duly attested by Notary public with notarial stamps of appropriate value affixed thereon.*
4) ***** strike out whichever is not applicable.*

Bid Document for Works

(Two-Envelope Bidding Process Without Prequalification)

Procurement of:

Design, Supply, Installation, Testing & Commissioning of Signalling & Telecommunication system in connection with yard remodelling at Patli station (Existing N. Rly. station in Delhi-Rewari section) for Haryana Orbital Rail Corridor (HORC) project

Bid No: HORC/HRIDC/Patli/S&T/2023
Contract title: Patli S&T Tender (Design and Build on BOQ basis)
Project: Haryana Orbital Rail Corridor Project
Employer: Haryana Orbital Rail Corporation Limited
Country: INDIA
Issued on: 21.04.2023

Volume II
Bill of Quantities
(To be signed and uploaded with Price Bid

Bill of Quantities

1. Preamble

1.1 The Bills of Quantities (BOQ) shall be read in conjunction with the Instructions to Bidders, the General Conditions of Contract, the Special Conditions of Contract, General Specifications, Particular Specifications, the Drawings and the Addenda/Corrigenda (if any).

1.2 The quantities given in the Bills of Quantities are estimated and provisional and are given to provide a common basis for Bidding. The basis of payment will be the actual quantities of work ordered and carried out, as measured by the Contractor and verified by the Engineer and valued at the rates and prices in the priced Bill of Quantities, where applicable, and otherwise at such rates and prices as the Engineer may fix within the terms of the Contract.

1.3 The rates quoted in the priced Bill of Quantities are for complete and finished items of the work in all respects. The rates and prices shall, except in so far as it is otherwise provided under the Contract, shall include all design, manufacture, supply, installation, testing commissioning, all necessary survey work, plants , tools, machinery, labour, compliance of labour laws, supervision, materials, transportation, handling, loading & unloading, storage, sampling, 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.), restatement, remedy of any defects during the Defects Notification Period, safety measures for workmen and road users, preparation of design and drawings pertaining to the 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 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.

1.4 The cost of all the items as detailed in General Specifications and Particular Specifications shall be deemed to have been included in the rates and prices in the priced Bill of Quantities unless otherwise specified in the Contract.

1.5 General directions and descriptions of work and materials are not necessarily repeated nor summarised in the Bills of Quantities. References to the relevant sections of the Contract Documents shall be made before entering rates and prices in the priced Bill of Quantities.

1.6 The Bidders shall quote percentage rate (%) Excess(+)/Less (-) against total value of each Bill number.

1.7 The description of items in the BOQ are not exhaustive, and hence the Contractor shall be required to execute all necessary works required for completion of the concerned item of the BOQ in accordance with the Contract.

2. Deleted

3. Measurement and Payment

3.1 As already stated under 1.1, the prices and rates quoted shall be comprehensive and must include cost for complying in all respects with the Bill of Quantities, Instruction to Bidders, the General Conditions, the Special Conditions, Specifications and Drawings and for all matters and things necessary for the proper construction, completion, and making good of any defect in of the whole of the Works.

3.2 No claims for additional payment will be allowed for any error or misunderstanding by the Contractor of the work involved.

3.3 The measurement shall be made as per Bill of Quantities, General Specifications, Particular Specifications, the Drawings and other relevant provisions of the Contract.

4. Procedures for Payment

4.1 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, as certified by the Engineer on the basis of the progress achieved for the items of works/stages of the works.

4.2 The Contractor shall base his claim for interim payment in accordance with Sub-Clause 14.3 [Application for Interim Payment Certificates] of the General Conditions for various items of work on the basis of actual progress of work executed 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 Works Requirements.

4.3 The Employer may carry out necessary test checks, 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 test checks.

4.4 Format for the Contractor's application for payment shall be agreed between the Engineer and the Contractor.

4.5 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 by the Contractor, certified by the Engineer and submitted to the Employer.

4.6 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.

4.7 The Employer may deploy external agencies, other than the Engineer, to cross check the work done by the Contractor. If at a later stage it is discovered that excess payment has been released to the Contractor or the work is found to be defective, suitable recoveries would be affected from the first available bill of the Contractor.

4.8 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.

5. Methodology for Claiming Payment

5.1 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.

5.2 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 two 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.

6. Work Items

The Bill of Quantities usually contains the following part Bills, which have been grouped according to the nature or timing of the work:

Bill No. 1: Signalling Indoor Works- Supply of Material
Bill No. 2: Signalling Outdoor Works- Supply of Material
Bill No. 3: Signalling Installation, Testing & Commissioning
Bill No. 4: Telecommunication- Supply of Material
Bill No. 5: Telecommunication- Installation, Testing & Commissioning
Bill No. 6: Maintenance of Signalling & Telecommunication System

7. Payment Terms

7.1 Bill No. 1, 2 & 4: Supply of equipment & material:

i) 70% of payment for items shall be made to the Contractor on receipt of:

a) Bill/ Tax invoice

b) Receipt of material at site/ Employer's project depot managed by the Contractor

c) Insurance of material for the project execution period

d) Inspection certificate from the competent inspecting authority

e) Delivery Challan

f) Certificate from the Contractor & OEM that material being supplied is new with latest version and complies with the Specification

g) Commitment from OEM for support to the Contractor/ HORCL/ Railway for the product being supplied and minimum for 7 years.

ii) 20% payment shall be made on installation & commissioning of equipment/ material at site

iii) 10% payment shall be made on commissioning of complete work & issue of Taking Over Certificate.

7.2 Bill No. 3, 5: Installation & Commissioning:

i) 90% payment shall be made on execution/ installation & commissioning of item at site.

ii) 10% of payment shall be made on commissioning of complete work & issue of Taking Over Certificate.

Bill of Quantities

Bill No. 1: Signalling Indoor Works- Supply of Material					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
1	Design & Supply of EI system with hot standby architecture as per RDSO spec. No. RDSO/SPN/192/2005 Ver 2.0 or latest to cover the following: Distributed EI at Patli. Essential spares of cards and Relays @10% for station as per RDSO specification. "It includes a) all required cards, DC-DC convertors for power supply, mother boards, housings, communication/networking eqpt to make the EI system functional as per the SIP of Patli station attached. b)All interface Relays (for Indoor only) Like QN1, QNA1, QBCA1, QSPA1, ECR Relays etc. should be included along with this item. Employer will supply only Outdoor Relays. c) OFC connectivity/ patch cords as per requirement of system. d) Design & supply of Relay racks, wire coils and relay wiring accessories. This includes indoor wiring of vital I/Os from EI system upto CT rack alongwith design of circuits & preparation of wiring Diagrams e)Lightening protection arrangement at all locations as prescribed by RDSO for EI installations f) Any other item necessarily required for working of EI installation and to make system functional and not getting covered under the Schedule shall be incorporated under this item. Tenderer shall submit along with the financial bid the detailed list of	Nos.	12971700	1	12971700

Bill No. 1: Signalling Indoor Works- Supply of Material					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
	break up of sub-items of EI system covering Station wise Qty. (working & spares separate), total qty, rate & total amount for each sub-item with grand total matching to the Tendered cost for this item. Spares @ 10% rounded off (min 1) of essential items as specified by OEM.				
2	Supply of Maintenance terminal for event & fault logging with 42" LED monitor as per latest RDSO guidelines with A-4 size color deskjet printer, UPS & with all necessary communication arrangement. This should also include furniture i.e. table & chair for keeping MT with all accessories.	Nos.	746705	1	746705
3	Submission of as made Documents for EI (Complete Set).	Nos.	75175	1	75175
4	Modification/ addition to existing 512 port digital input and 32 port analog input datalogger with built in network internal modem and power supply as per RDSO Specification No. IRS : S-99/2006 (Amend-3) or latest amendments or as per latest specification. This also includes Protocol convertor for data logger .	Nos.	590733	0.5	295366
5	Provision/ Augmentation of IPS as per RDSO/SPN/2012 Ver. 3.0 or latest amendment and as per Drg. And summary sheet attached with the Purchase Order to additional load.	Nos.	1047650	0.5	523825
6	Supply of cable indoor Cu conductor multi core plain annealed, high conductivity 660V PVC insulated unarmored but PVC sheathed to specification No: IRS/S/76/89 amendment 2 or latest size 1*60C*0.60sq mm dia.	Km	172440	0.5	86220

Bill No. 1: Signalling Indoor Works- Supply of Material					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
7	Supply of 1C*.79 Sq.mm.(1/1 mm) PVC insulated unsheathed single core cable as per IRS/S:76/89 with latest amendment	Km	7921	0.5	3961
8	Supply of UFSBI for Single/Double line complete with all accessories as per RDSO spec No RDSO/SPN/188/ 2004 ver 1.0 or latest amendment. (1Set). Each set consisting i) UFSBI (RDSO SPN No SPN/147/2005 or latest amendment = 2 no. ii) Relay rack with due locking & sealing arrangement including relays = 2 Nos. iii) Block Panel complete with accessories as per latest amendment= 2 nos. iv) Block telephone with accessories as per RDSO spec no RDSO/SPN/191/2006= 2 Nos.	Set	1127915	2	2255831
9	Supply of Key lock relay, type TMA 24V DC with 2F/2B contacts configuration with different wards combination. Details of ward combination will be provided during execution of work.	Nos.	7436	5	37181
10	Supply of Relay- Relay, AC immune ,plug in type, style QNA1,DC neutral line relay,24 V DC 8F/8B contacts, front & back contacts metal to carbon with plug board retaining clip & connectors confirming to BRS:931A,IRS:S@ 45<47N44@ IRS:S@ 45"47@ 68 & IRS:S-23/88 as applicable. The interlocking code for this unit shall be ABDGH or latest.	Nos.	3040	50	151978
11	Supply of flexible cable single core Red & Black color multi strand 1x 10Sq mm as per IRS 76/89 with latest amendment.	Km	131749	1	131749

Bill No. 1: Signalling Indoor Works- Supply of Material					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
12	Supply of 16/0.2mm size tinned flexible single core indoor wire IRS:S 76*89 Amend No.2 or with latest amendment / specification, PVC coated in different colours as per technical specifications and to be supplied in coils of 100 meters.	Nos.	838	200	167532
13	Fabrication, wiring & Supply of Simulation panel as per drawing no. SSTE/ PS/1562 dt. 5.9.2001. This includes wiring from Relay room to the simulation panel. Only indoor cables (for wiring between relay room and simulation panel), ARA terminals and fuse bases shall be supplied by Employer (Covered in this schedule at other Sno.).All materials such as on/off/2way switches, wires, strips & tag blocks etc. to be supplied by the contractor (unless explicitly mentioned in this item as Employer supply).	Nos.	5779	1	5779
14	Fabrication, wiring & Supply of lamp board as per drawing no. SSTE /PS / 1563 dt. 5.9.2001. This includes wiring from Relay room to the lamp board. Only indoor cables(for wiring between relay room and lamp board) shall be supplied by Employer. All materials such as wires, strips, tag blocks, lamps & holders etc. including sufficient lamps for testing to be supplied by the contractor (unless explicitly mentioned in this item as Employer supply).	Nos.	9754	1	9754

Bill No. 1: Signalling Indoor Works- Supply of Material					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
15	Fabrication, supply and fixing of relay racks along with scaffolding as per Drg. No. NR/S&T/Project/14/2015 fitted with M.S. squares bars duly ionized along with description strips to accommodate Plug-in-type relay groups/Point contractor units/ Route checking relays etc. Scaffolding/ cable carrier to be fabricated of angle iron of size 35 mm X 35mm X 6mm and flat of size 25mm X 5mm as per instructions of Engineer's Representative. The Separation between two flats shall be 250 mm or less as per site requirements. All fixing material like anti-tilting device if required, bolts, nuts, washers, insulators, shoe, angle irons, flats, L - bolts, sand, cement & concrete etc. will be supplied by the contractor. This also includes cleaning, priming by Red oxide, painting of racks and writing of description of relays by Indian Standard mark paints.	Nos.	17454	2	34909
16	Fabrication, supply and fixing of cable termination board of size as per Drg. No.NR/S&T/Project/13/2015 duly fitted with Bakelite sheet of size 6mm thick. This also includes fixing of ARA terminals & fuse bases. Supply and fixing of hard wood of size 100 cmx 100 cm x 5 cm in the back for jamming of cables. All the fixing materials like bolts, nuts, washers, Insulators, shoe, angle irons, flats, Lbolts, cement, sand and concretes etc. will be supplied by the contractor. This includes cleaning, priming by red oxide, painting & writing of description etc. with Indian standard mark paints.	Nos.	18794	2	37587

Bill No. 1: Signalling Indoor Works- Supply of Material					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
17	Supply of MROtech -TEC make mapple or equivalent 4c 1U 19 rack mountable device consisting of 4 EI pouints and slots and 1 slot populated with 2W/4W E&M supporting upto 8 interface balance 2 slots empty connect with 50 pin cable 1 No. for supporting 2W/4W E&M AC adaptor 1 No. for BPAC connectivity.	Nos.	91370	4	365479
18	Supply of electric fuse complete with fuse block made of PBT for Railway signaling as per IRS-S75/2006 Rev 2 or latest, fuses non-deteriorating type low voltage, to suit Specn. No. IRS: S-78/92 or latest, 2 Amp/4 Amp/10 Amp/16 Amp fuses in ratio of 50:20:20:10. Fuse block shall be suitable for round head type fuses.	Nos.	208	60	12476
19	Supply of 200 way tag block complete with cover conforming to Drg No. SA24753 or latest as per IRS S-77/2006 rev 1 or latest	Nos.	1384	4	5534
20	Supply of desk type magneto telephone to suit IRS TC:36-97(Amndt.1)	Nos.	4659	5	23296
21	Supply of Relay, Non AC immune ,plug in type, style QN1,DC neutral line relay,24 V DC 8F/8B contacts, front & back contacts metal to carbon with plug board retaining clip & connectors confirming to BRS:931A,IRS:S@ 45<47N44@ IRS:S@ 45"47@ 68 & IRS:S-23/88 as applicable. The interlocking code for this unit shall be ABCDF or latest.	Nos.	2885	21	60582

Bill No. 1: Signalling Indoor Works- Supply of Material					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
22	Supply of QTA2 relays AC immunised plug in type DC 9 Ohm neutral track relay miniature tractive armature with 2F/1B contacts as per BRS : 939A or latest amendments if any, BRS :966-F2, IRS-S-34 & IRS-S-23 (as applicable)	Nos.	4913	20	98252
	Sub-Total of Bill No. 1 (INR)				**1,81,00,870**

Bill No. 2: Signalling Outdoor Works- Supply of Material					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
1	Supply of High availability SSDAC system complete with dual sensor as per RDSO specification No. RDSO/SPN/177/2012 with version 3.0 or latest consisting of: i) Track side high availability DAC unit = 2 Nos. v) High Frequency Tx coil and Rx coil) (each set consists of web mounted type 2 Nos. of Tx coil and 2 no Rx coil)- 2 set. vi) Vital relay box =2 Nos. duly wired with following relays: a) Vital relay QN1K: 24V 6F/6B- 2Nos. b) Reset relay: QN1K24V 6F/6B= 1No. c) PR Relay: QNN1-24 V - 6F/2BDual- 1No. vii) Clamp with deflector plates and hardware-4 Nos. viii) Reset Box-2 Nos. ix) Surge voltage protection device mounted on DIN Rail-2 Nos.	Set	867440	4	3469760
2	Supply of Electric Point Machine (IRS type) AC immunity 160 V AC, Non trailable to operate on 110 V DC, 143 mm throw with interlocking complete with lock, detector, cable terminal box and slides for lock & detector, rotary locking as per specification No. IRS-S24/2002 with amendment-1 or latest.	Nos.	63579	11	699369
3	Supply of complete set of point rodding for point machines of IRS type as per latest drg. & specifications along with 'P' brackets, all type of nuts & bolts and Lugs as reqd also to be supplied with each set.	Nos.	9150	11	100650

Bill No. 2: Signalling Outdoor Works- Supply of Material					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
4	Supply of Insulation for 'L' type bracket for point fitting IRS type complete consisting of Insulation plate - 01 No. Ferrule - 02 Nos. Washers - 04Nos. (Material Nylon 66) (Complete Set) .	Nos.	373	11	4099
5	Supply of Insulation for P bracket for point fitting IRS type complete set.	Nos.	963	11	10598
6	Supply of colour light signal unit 2 Aspect complete without lamp holder, lamp, lenses and signal transformer as per IRS -S- 26/64 Ver. 1 and RDSO Drg no.SA-23003 A/ M(Adv.) or latest.	Nos.	15569	4	62275
7	Supply of colour light signal unit 3 Aspect complete without lamp holder, lamp, lenses and signal transformer as per IRS -S- 26/64 Ver. 1 and RDSO Drg no.SA-23002 A/ M(Adv.) or latest.	Nos.	19750	7	138248
8	High power LED Aspect for main signal with Polycarbonate lens conforming to Indian railway chromatically standard and the specification no. RDSO/SPN/153/2004 (Rev.3) with electrical shunt and thermal control means (This includes current, regulator, health monitoring unit, fuses and other accessories required for fixing.				
	a) For Red Aspect	Nos.	13121	8	104964
	b) For Yellow Aspect	Nos.	13135	11	144485
	c) For Green Aspect	Nos.	15447	6	92683
9	Supply of Calling ON signal unit position light type complete with mounting socket 90 mm dia. & lock. All items shall be as per latest RDSO drawing and specifications.	Nos.	4353	3	13059

Bill No. 2: Signalling Outdoor Works- Supply of Material					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
10	Supply of route indicator junction type complete with hoods & offset bracket 5½ " without signal transformer as per RDSO Specn.No.IRS-S-66/84 Amd. 1 or latest as per latest drawing. A) 1-way route indicator junction type Drg. No. SA-23401 (Adv.) or latest	Nos.	22523	0	0
11	2/3/4/5-way route indicator junction type Drg. No. SA-23402-6 (Adv.) or latest	Nos.	29315	7	205206
12	Supply of shunt signal position light with unit offset bracket 3.5" dia. without holders & bulbs as per drg.no. SA -23840 adv.specs.no.IRS-S-23/88 or latest Dependent post type.	Nos.	8311	2	16623
13	Supply of shunt signal position light complete with unit post and surface base mounting socket 90mm dia, without holders & bulbs as per drg. No. SA 23840, adv.specs.no.IRS-S-23/88 or latest independent post type.	Nos.	8453	3	25360
14	Supply of LED type Shunt signal aspect (in place of one bulb) complete with current regulator and health monitor alarm as per spec no. RDSO/SPN/153/2002 or latest.	Nos.	7565	13	98345
15	Supply of Hand Cuff Lock with key of approved type of signal units.	Nos.	450	10	4500
16	Supply of CLS Signal post 4.6 M and ladder 4.5 M long with base (S-2011/M), and platform as per RDSO spec.No.IRS-S-6/81 or latest.	Nos.	18366	9	165291
17	Supply of CLS Signal post 3.6 M and ladder 3.5 M with base (S-2011/M) and platform as per RDSO spec.No.IRS-S-6/81 or latest.	Nos.	16709	3	50127

Bill No. 2: Signalling Outdoor Works- Supply of Material					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
18	PVC Insulated Armoured, Unscreened, Underground Railway Signalling Cable Copper Conductor as per specification no. IRS-S-63/2014 {Rev. 4.0} or latest with amendment Size 24 Core x 1.5 Sq. mm.	Km	354317	7	2515648
19	PVC Insulated, Armoured, Unscreened Underground, Railway Signalling Cable Copper Conductor as per Spec. no. IRS-S-63/2014 (Rev.4.0) or latest with amendment, Size 19 Core x 1.5 Sq. MM.	Km	284800	5	1424002
20	PVC Insulated Armoured, Unscreened, Underground Railway Signalling Cable Copper Conductor as per specification no. IRS-S-63/2014 {Rev. 4.0} or latest amendment as on the date of opening Size 12 Core x 1.5 Sq.mm	Km	182731	40	7301931
21	PVC insulated Armoured, Unscreened, Underground Railway Signalling Cable Copper Conductor as per Specification No.IRS:S-63/2014 (Rev.4.0) or latest amendment as on the date of Opening of tender, size 6 core x 1.5 Sq.mm	Km	105021	1.0	105021
22	Supply of PIJF- Polythene insulated filled telephone cable with poly-AL moisture barrier with armoured of size 10 PAIRx0.63mm. As per spec IRS:TC-41/97 Amendment No.1 or Latest.	Km	83,735	1	83735
23	Supply of apparatus case Single with 'E' type lock and key ward no.42 and handle as per RDSO drg. No. RDSO/S-11500.	Nos.	20987	30	629625
24	Supply of apparatus case steel half with E type lock and key ward no. 42 and handle as per RDSO Drg.no. RDSO/S-11507.	Nos.	16242	5	81209

Bill No. 2: Signalling Outdoor Works- Supply of Material					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
25	Supply of Disconnect Terminal block for Four conductor with screwless Cage Clamp type/sliding switch disconnect as per RDSO Specification No. RDSO/SPN/189/2004 version 1.2, for each conductor size upto 2.5 sq. mm. Equivalent of M6 Terminals. Each Terminal block equipped with two markers on top and bottom, an end plate, 2 end clamps & adequate length rails for fitting terminal blocks.	Nos.	209	600	125592
26	Supply of ARA terminal block 25mm centre small M-6 terminal made of PBT as per RDSO drg. no.SA-23741-A,(Alt.-4) spec.no.IRS-S75/2006 amendment - 2 or latest.	Nos.	70	600	41880
27	Supply of track feed batt. charger 110VAC/2-4-6 VDC / 10 Amps as per RDSO spec. no. IRS S-89/2013 Ver. 1 with Amdt. 1.	Nos.	3872	20	77447
28	Supply of track feed variable resistance (with phenolic moulded base) 30 ohms to suit RDSO Drg no. SA-20166 / Adv (latest)	Nos.	363	20	7268
29	Supply of choke type 'B' to suit RDSO spec no IRS-S65/83(Amndt.3) or latest.	Nos.	3568	20	71367
30	Supply of Fiber type Track lead Jn. Box as per IRS(s) Drg. No.SA-20101/M made of FRP material (FRP material conforming to RDSO SPN 151/97 or latest) complete with 450 mm long 25 mm dia. pipe.	Nos.	1202	40	48079

Bill No. 2: Signalling Outdoor Works- Supply of Material					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
31	Supply of Lead acid secondary cell 2V/80 AH with tubular positive & pasted negative plates assembled in hard rubber case container as per spec no IRS-S88/2004 Ver. 1 or latest.	Nos.	2693	60	161574
	Sub Total of Bill No. 2 (INR)				**1,80,80,019**

Bill No. 3: Signalling Installation, Testing & Commissioning					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
1	Installation, testing & commissioning of Electronic interlocking system as per RDSO specification No. RDSO/SPN/197/2008 or latest at station	Nos.	355866	1	355866
2	Installation, Wiring, Testing, Validation and Commissioning of 512/1024 port digital input and 32 port analog input datalogger systems with networking. Datalogger system to be supplied by Employer (included as separate item in this schedule). This includes wiring of all the functions terminated at terminal strip in RR/RH to data logger. (Necessary wiring material and strip connectors to be supplied by the contractor). Provision of cable carrier is included as separate item of this schedule.	Nos.	88162	0.5	44081
3	Installation & commissioning of UFSBI for Single/Double line complete with all accessories as per RDSO spec No RDSO/SPN/188/ 2004 Ver. 1.0 or latest amendment. (1Set). Each set consisting of following: (i) UFSBI (RDSO SPN No SPN/147/2005 or latest amendment = 2 no. (ii) Relay rack with due locking & sealing arrangement including relays = 2 Nos. (iii)Block Panel complete with accessories as per latest amendment= 2 nos. (iv) Block telephone with accessories as per RDSO spec no RDSO/SPN/191/2006= 2 Nos.	Set	117888	2	235776

Bill No. 3: Signalling Installation, Testing & Commissioning					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
4	Prep. of cable route plan, Track crossing plan, Cable core chart, Power supply arrangement, Cable termination chart in relay room, relay huts and location boxes, Location Description plan, Cable insulation chart and register, Track circuit history card, Track circuit plan, Outdoor circuits and other outdoor diagram for way side stations. Three sets of above diagrams will be submitted for approval & for execution of work. The supply of completion document after commissioning of the work shall be as per following details:- (i) Supply of 6 copies of completion set of A-3 size drawings of superior quality paper, laminated, properly bound in steel clip jaw file with cushioned cover. Cable route plan, cable core plan & other bigger size prints to be of ferro prints but without lamination. (ii) Software back up of complete set in the form of CD/Pen drive/Other (3 sets). (iii) One complete set of tracings. (iv) Design through CAD (v) Drawings in A3 & plans in bigger size. (six sets)	Job	41185	1	41185
5	Installation, testing & commissioning of HASSDAC. This includes integration of HASSDAC with block instruments.	Set	73467	4	293869

Bill No. 3: Signalling Installation, Testing & Commissioning					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
6	Fixing, wiring, testing and proper adjustment of point machines as per std. Practice. It also includes -i) Fixing of switch extension / P bracket, providing insulation for switch extension bracket/P-bracket/L-bracket , fixing ground connection, adjusting the correct opening of switches and adjusting the point machines with crank handle. ii) Supply of wiring material and wiring inside the point machine & 30 line junction box provided with terminals strip for cable termination. iii) Supply and fixing of GI pipes with flange for taking cable into point machine and junction box through Gland/ GI pipe. iv) Complete material for installation viz.GI pipes/Gland Pipe, wiring materials, various fixing nuts and bolts, angle irons (75mm x 75mm x 10mm), channel for fixing the machine, lugs for point rodding and insulation for stretcher bar 90R/52/60Kg. As per RDSO drawing No.SA-23172(Adv.) Alt. 1 will be supplied by the contractor. **Note:** For Shifting of Engineering points in yard, ith shall be first installed outside the track to facilitate adjustment of point machine and ground connection etc. and then it shall be reassembled inside the track.	Nos.	8384	11	92222
7	Installation of KLCR & its box in location boxes, supply & installation of heavy duty push button, LED indicator on M.S sheet of 4.5 mm thick inside location box for crank handle locking. The work includes fixing & wiring of magneto telephones, wiring of KLCR, push buttons and termination of tail cables as per instructions of Engineer's representative. All material except	Nos.	9437	5	47186

Bill No. 3: Signalling Installation, Testing & Commissioning					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
	KLCR relay & its box and magneto telephone (Covered in this schedule at other Sno.) to be supplied by the contractor. This also includes fixing of wards on point machine. Foundation & installation of location box is covered as separate item of schedule. (Per unit is Per Installation).				
8	Termination of all type of cables at either end on terminal boards providing identification, ferrules, dressing, lacing with thread. This includes testing, meggering and submitting test reports etc. and defect integration.	Per conductor	13	751	10077
9	Installation, erection, wiring of 2 aspect color light signal.	Nos.	2833	4	11331
10	Installation, erection, wiring of 3/4 aspect color light signal.	Set	4147	7	29027
11	Installation, erection, wiring of 2/3/4 aspect colour light signal including 1/2/3/4/5 way Jn. type/Stencil/Theatre type route indicator which also includes fixing of route indicator on the top of the signal post or on offset bracket including fixing of offset bracket, wiring the whole unit, focusing of signal & route indicators. All items for installation and erection including unit junction type route indicator and offset bracket to be supplied by the Employer. Wiring & other fixing material, 'U' bolts will be supplied by the contractor.	Nos.	4083	3	12250

Bill No. 3: Signalling Installation, Testing & Commissioning					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
12	Installation, erection and wiring of calling-on / shunt signal on the same post below main signal on offset bracket. Which also includes fixing of stencil and hoods, wiring and focusing of the signal. Offset brackets, calling on signal/shunt signal complete will be supplied by the Employer. (Supply of Offset brackets, calling on signal/shunt signal complete is covered separately, elsewhere in the schedule). U-bolts for offset bracket & wire and wiring material will be supplied by the contractor.	Nos.	926	5	4628
13	Installation, erection and wiring of independent position light shunt signal/F Marker. This includes fixing of shunt signal, surface base & signal post, LED & wiring of shunt unit. All material such as wire etc. will be supplied by the contractor.	Nos.	1124	3	3372
14	Casting, concreting and curing of foundation for main signal as per Drg. no. NR/ S&T/ CON/2.1/97 all material such as anchor bolts cement & aggregate to be supplied by contractor.	Nos.	10722	11	117946
15	Casting, concreting and curing of foundations for shunt signal as per drg. No. NR/ S&T/ CON/2.1/97-A. All material such as cement, sand, aggregate & foundation bolts will be supplied by contractor.	Nos.	3594	3	10781
16	Casting, concreting, curing of foundations and erection of WARNING BOARDS(SLB/BSLB/SB/GWB/Calling on Boards) as per drg. No. NR/S&T/Proj/17/2017 Supply of Warning boards as per SEM has to be done by the contractor. Board should be provided on I -Shaped channel having minimum weight of 8.9 kg/meter and length 5000mm.Channel to be supplied by the contractor.	Nos.	9134	4	36536

Bill No. 3: Signalling Installation, Testing & Commissioning					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
17	Casting, concreting, and curing of foundation and erection of Single app. cases as per Drg.No.NR/S&T/CON/2.7/97. All material such as cement, sand, aggregate and anchor bolt shall be supplied by contractor. App. Case Single will be supplied by Railway. Contractor is required to execute all type of repair works of foundation if required during inserting the cable for termination.	Nos.	5788	31	179433
18	Casting, concreting and curing of foundation and erection of half app. cases as per Drg.No.NR/S&T/CON/2.8/97. All material such as cement, sand, aggregate and anchor bolt shall be supplied by contractor. App. Case half will be supplied by Employer (Covered in this schedule). Contractor is required to execute all type of repair works of foundation if required during inserting the cable for termination.	Nos.	5078	5	25392

Bill No. 3: Signalling Installation, Testing & Commissioning					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
19	Preparation of bakelite hylum sheet 910x800x6mm and teak wooden shelf 900x450x25mm duly fixed by angle iron piece of different size inside all the app. Cases. Hylum board shall be fixed on an angle iron frame of 25mmx25mmx3mm. Angle iron frame will be fixed in location boxes secured by nuts & bolts. Fixing of fuses, ARA terminal shelf type Q series relays and other type relays on square bars fixing and jamming of cables with 2 inch thick salwood plank provided at the bottom. This will include opening, pasting and jamming armour of each cable in the hole drilled separately for each cable through the salwood plank & all cable entry points on location boxes, location huts, JB's relay room/battery room to be closed with suitable masonry works covered with sand and plastering. Description for terminal drawing of circuits, inside app. Case. Painting from out side as well inside with red oxide and aluminum paint is covered separately. Size of lettering will be 100mm or as per instructions of Engineer' Representative. All materials including hard wood shelf, hylum board, salwood plank, angle iron square bar, wire and wiring material as per the IRS specn., non-deteriorating type HRC fuses, bases, nuts and bolts, Relays, ARA Terminals and other items shall be supplied by the contractor. a) Preparation of App. Case single involving wiring of relays.	Nos.	5968	6	35809

Bill No. 3: Signalling Installation, Testing & Commissioning					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
20	Cleaning, Scrapping , Painting and lettering of all newly installed and existing gears (if any) such as signals, point equipment, track detection equipment with numbering on rail, app. Cases, JB, Track detection point, point rodding cranks, compensators etc. including gate equipment if existing in station section as per the provision of IRSEM. All painting material to be supplied by the contractor. All paints (ISI marked) shall be approved by the Engineer prior to painting and certificate to this effect submitted to the Engineer. This item also includes writing and painting requirement of all indoor and outdoor gears along with making of all circuit nos. near terminal and terminal boards/track in app. cases, junction boxes, relay room, SMs room, writing of relay nomenclature fuse nos. and equipment nomenclature as the approved plans and as per provision of IRSEM at Way side station.	Station	23027	1	23027
21	Fixing, wiring & soldering of 200 way tag blocks, conforming to drg no. SA24753 or latest and as per IRS:S-77/2006(Rev.1) or latest, on cable termination rack/relay rack/block rack/HV rack . All fixing material like flats, bolts, nuts, washers etc. will be supplied by the contractor. Only 200 way tag blocks shall be supplied by employer (covered in this schedule).	Nos.	158	4	633
22	Installation of desk type magneto telephone with all accessories including Standard battery box and 3 nos. of 6 I cells. All materials for this installation including standard battery box and 6I cells will be supplied by the contractor. Only desk type magneto telephone will be supplied by Employer (Covered in this schedule).	Nos.	570	5	2849

Bill No. 3: Signalling Installation, Testing & Commissioning					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
23	Installation of DC track circuits to suit RE area as per std. Practice. This will include following:- a) Drilling of holes 7.2 mm dia or size as required. Provision of continuous GI wire bonding on switch portion & crossing of points with two bond wires at each joints. 8 SWG GI soft bond wire, channel bond pins & all other material required will be supplied by the contractor. b) Jumpering from rail to rail or to track lead junction box including polarity jumpers /cables in case of point track circuit as per drg. No.NR/S&T/CON/3.1/97 and as per jumpering plan. This includes drilling holes, fixing of jumpers to the rails , terminating the jumpers in the TLJBs and fixing the jumper as per site requirement and instructions of site Engineer. One TLJB to be provided extra for each polarity jumper/cable. All materials including fiber TLJBs, GI pipe are to be supplied by the contractor.				

Bill No. 3: Signalling Installation, Testing & Commissioning					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
	c) Fixing of insulated block joints complete with provision of skimmed fish plates (where ever required). Fish plates shall be supplied by the Railways but skimming is to be got done by contractor. Supply of insulation material is not included. d) Fixing of TLJBs as per drg. No.(NR/ S&T/ CON/ 3. 2/ 97) along with providing concrete foundation and plastering on both ends i.e. T.F. and TR end and termination of tail cables at both ends. All material for fixing including angle iron, cement, sand etc. shall be supplied by the contractor. This also include supply of TLJBs with provision of M-6 terminals. TLJBs to be written with track circuit number. e) Wiring in the app. Case of TF battery chargers, TF resistances 30 Ohm, track relays, chokes (at both feed end and relay end) & batteries etc. as per the standard practice using NDT fuses with fuse bases and terminals. This include supply of all material by contractor except TF battery charger, batteries, fuse with bases, Choke and relays which shall be supplied by the Employer (Covered int this schedule at other Sno.). The wiring shall be done with 3/0.029" copper conductor PVC wire of approved quality. f) Commissioning of track circuits as per provisions of paras of IRS spec. No. S-36/81. This includes adjustment of track feed resistance and testing with train shunt resistance.				
	(i) Installation & wiring of Berthing and straight track circuit.	Nos.	9548	8	76383

Bill No. 3: Signalling Installation, Testing & Commissioning					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
	(ii) Installation & wiring of Point track circuit having single point (excluding traps. Trap points & one main point to be counted as single track circuit).	Nos.	16510	10	165098
24	Dismantling of items **General Notes:** 1) Before dismantling a joint survey is to be done with the site Engineer and report must be submitted to the controlling officer in duplicate. Tools & plants, ladders, scaffoldings and all other equipments required for dismantling to be arranged by the contractor at his own cost. 2) The rates given for dismantling are subject to the following conditions in addition to the conditions as laid down in NR General conditions of contract and Standard Specifications. 3) Unless or otherwise specified the rates covers the cost of tools & plants, ladders, scaffoldings and all other equipments required for dismantling. 4) Unless otherwise specified, the rates includes leading of material up to the store of SSE/C/JUC, stacking dismantled material in the store as required specially item wise or transporting to SSB depot or JUD workshop as per directions of site engineer.				
	a) Dismantling and releasing of colour light signal/ semaphore signal post which includes dismantling of signal fittings complete. All dismantled material to be transported and stacked in the store of SSE/SIG/Store/JUC or any other store of Northern railway.	Nos.	1193	4	4771

Bill No. 3: Signalling Installation, Testing & Commissioning					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
	b) Dismantling and releasing of location boxes/Apparatus cases/Jn boxes including releasing of terminal boards, relays, terminals, fittings installed therein. complete with fittings. All dismantled material to be transported and stacked in the store of the Employer.	Nos.	683	15	10250
	c) Dismantling and releasing of point signalling gears which include facing point lock/ hand plunger lock/ lock bar/holding bar/electric point detector/mechanical detector along with their complete attachments.	Nos.	1301	3	3903
25	Excavating and refilling of trench in Normal Soil to the level of ground with rammed earth as per drg. No. (NR/S&T/CON/1.1/97-A) so as not to form a drain 0.3 Mtrs. Wide & 1 Mtr. Deep on both side of the station alongside the track. It shall conform to the safe distance as per signalling and cable plan. It also includes clearance of routes of trees & bushes. Lesser depth of the trench is to be paid proportionately.	Metre	73	5,000	363250
26	Excavating and refilling of trench in Rocky soil to the level of ground with rammed earth so as not to form a drain 0.3 Mtrs. Wide & 0.5 Mtr. Deep on both side of the station alongside the track. This Includes 50mm thick concreting work throughout in 1:3: 6 ratio. All concreting material to be supplied by the contractor. It shall conform to the safe distance as per signalling and cable plan It also includes clearance of routes of trees & bushes.	Metre	128	400	51200

Bill No. 3: Signalling Installation, Testing & Commissioning					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
27	Excavating and refilling of trench 0.3 Mtr./ as required Wide & 1 Mtr. Deep from bottom of rail flange across the track or 0.5Mtr. from ground level whichever is more (NR/S&T/CON /1.2/97). Earth should be rammed so as not form a drain. This includes removal and refilling of ballast & restoration of surface under normal traffic conditions. Lesser depth of the trench is to be paid proportionately.	Metre	94	200	18798
28	Excavating and refilling of trench 0.3 Mtr. Wide and 0.8 Mtr. Deep on pitched/Stone/bricks paved surface, road crossing/platform etc. and restoring the surface to its original conditions. Lesser depth of the trench is to be paid proportionately.	Metre	114	20	2288
29	Supply & installation of Double walled corrugated HDPE Pipe of outer dia 120 mm (other than black in colour) (in 6m straight length with one coupler for every 6m length) conforming to BSEN-50086-2-4 for latest IS specification14930 Pt II wherever required as per approved cable route plan. This includes brick work and other arrangements required to secure the pipe as per specifications, drawings and stipulations of tender documents & as per approved cable route plan including road crossing/platform/track crossing & for bridges and culverts etc.	Metre	356	300	106869
30	Supply & installation of Half Split Double wall corrugated pipe of HDPE in 2 or 3 Mtr. Length produced out of full round DWC pipes with IS 14930 part- II mark on it. The pipe should have necessary fixing and coupling arrangements. Size : 200 mm outer dia. And 175 mm inner dia.	Metre	264	3,000	792000

Bill No. 3: Signalling Installation, Testing & Commissioning					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
31	Boring & trenchless cabling along with supply and insertion of HDPE self lubricated pipes of 90 mm nominal dia (DN) with material classification as PE80 and Nominal Pressure PN-6 as per IS:4984-95 (with latest Amendments) in the bore for the laying of Signaling/Telecom./Power cables under the track/road. Depth of horizontal boring should be minimum 1500 mm from bottom of rail flange/Road level. (Cable laying is covered separately).	Metre	1738	200	347678
32	Supply and laying of 2nd class bricks in the trench and laying as per drg. No. (NR/S&T/CON/1.1/97-A) as per instructions of the Engineer's representative. The bricks upto home signal shall be laid perpendicular (8-9 bricks/metre) and between home & distant longitudinal (4 bricks/metre)	Nos.	8	28,000	217560
33	Supply & installation of earth electrodes pipe of 3 metre length and 50 mm dia. pointed on lower end by tapering for a length of 150mm as per drg. No. NR / S&T/ Proj /16.1 /2015 and connecting with lightening arrester or signalling gears as per std. practices. The item includes digging of pit in earth 3 Mtrs. deep and fixing earth electrode pipe in it. Earth pipe shall be buried in the ground to the length of 2.7 Mtr after welding 6 SWG wire at the lower end and fixing through nut and bolt at the top. This includes casting of cement concrete enclosures as per drg. No. NR / S&T/ Proj /16.2 /2015 . The enclosure is to be plastered on all sides with cement & sand mixture of 1:4 ratio.	Nos.	3212	25	80305

Bill No. 3: Signalling Installation, Testing & Commissioning					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
	The soil treatment shall be done as per standard practices. The item includes provision of earth lead wires 6 SWG and soldering of lead wires. The other end of the earth wire to be connected to block instruments/ cable sheath/ power equipment / apparatus case/ relay racks or any other equipment as per the instructions of Engineer's Representative & as per IRSEM.				
34	Fabrication, supply and fixing of cable marker of 1:3:6 concrete as per No.NR/S&T/CON/1. 5/97A. The marker shall be fixed at various places of cable route as per instructions of the Engineer's representative.	Nos.	255	100	25500
35	Laying of signalling/Telecom/power/ other all type of cables etc. of different sizes as per drg. No.(NR/S&T/CON/1.1/97-A) and testing meggering of cable before and after laying.	Metre	8	53,060	443051
36	Supply & fixing of P/G/C markers with complete fittings as per drg. No. NR/S&T/Project/15/2015. All material required for the job such as MS sheet, MS angle. Nut and bolts, paint and painting materials will be supplied by the Contractor.	Nos.	735	6	4407
37	Provision of screen on signal when they fall within two meter from live conductor by expanding Metal size 20mm X 60mm (strand 3.25mm wide and 1.6 mm thick) as per instruction by engineer's representative. This includes supply of all materials including earth electrode and earthing arrangement.	Nos.	10140	2	20281
38	Supply of any other item required for end to end commissioning of signalling & telecommunication works not specifically covered in the schedule.				
	Sub-Total of Bill No. 3 (INR)				**43,46,869**

Bill No. 4: Telecommunication- Supply of Material					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
	Supply of SDH Add/Drop MUX (STM-1) for main/back up stream at stations in cable huts as per TEC specification No. TEC/GR/ TX/SDH/ 004/04 Jan 2011 or latest. with 2xL-1.1 Optical Interface, 2x5-1.1 optical interface, 21 E1 & 8ETH ports (10/100 base T) complete with power supply and all accessories, path chord and termination etc. Installation materials with all other accessories and technical manuals etc. The SDH equipment shall be as per TEC(TSEC)/RDSO specification.	Nos.	1,00,000	2	2,00,000
	Supply of 2 Mb programmable primary digital Drop Insert Mux as per IRS TC 68.04 with all interface cards, connection to 48 V bus bar and termination of VF/Data interface circuits to the Krone MDF in 42-U Euro rack. This includes termination of PVC cable at both ends and taking PVC cable over runway or on the wall. This also includes supply of PVC cable of conductor size 0.63mm. The MUX shall be equipped for 16 E&M VF circuits, 4 data circuits of 64 kbps, 6 hot line, /subscriber interface circuits. The equipment shall be RDSO approved. As per IRS.TC.68.04 with latest amendment. It	Nos.	1,52,060	2	3,04,120

Bill No. 4: Telecommunication- Supply of Material					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
	should be able to manage with the NMS of the section.				
	Supply of standard 19" covered rack 42U complete with all fittings and accessories for housing SDH equipment, primary MUXs and other equipment, using krone module and other equipment like runway ladders etc., completely wired and equipped for all channels as per technical specifications and other stipulations of tender document. It should be possible to lock all the equipment.	Nos.	38,163	1	38,163
1.	Supply of Fibre distribution management system including APC connectors, pigtails and accessories complete as per RDSO specification No. RDSO/SPN/TC/037-2000 (Rev 2) for two nos 24 fibre OFC in 19" rack.	Nos.	27,395	1	27,395
2.	Supply of Fibre termination board (FTB) for 24 fibre cables with connectors for 8 fibre.	Nos.	6,849	4	27,395
3.	Supply and Installation of Media converter as per TEC specification	Nos.	7,029	4	28,115

Bill No. 4: Telecommunication- Supply of Material					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
4.	Supply of 1120:470 Ohms VF isolation transformer rack mounting type as per RDSO specification IRS/TC/22/76 with latest amendment applicable on the date of opening of the tender. (Select joint type)	Nos.	1,345	12	16,142
5.	Supply of 4 wire way station equipment consisting of 4 wire control telephone, battery charger/Power supply with battery backup etc.	Nos.	9,235	4	36,941
6.	Supply of 1 KVA on line UPS with MFB battery backup for 30 min on full load as per specification (Tata Libert/APC/Vertiv)	Nos.	13,654	2	27,307
7.	Supply of 9 U 19" wall mounted rack complete with fittings, selfs, cable guide tec. for housing datacom equipment & cables etc.	Nos.	5,420	3	16,260
8.	Supply of Armoured Optical Fiber Cable (OFC) (24 Fiber) Mono Mode as per Spec. No. IRS-TC – 55/2000	Km	85,690	10	8,57,765
9.	Supply of PIJF- (Polythene insulated jelly filled) telecom cable with poly-AL moisture barrier with armoured of size 10 PAIRx0.63mm. As per spec IRS:TC-41/97 Amendment No.1 or Latest.	Km	83,735	2	1,25,603

Bill No. 4: Telecommunication- Supply of Material					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
10.	Supply of Permanently Lubricated High Density Polyethylene (PLB-HDPE duct) duct of outer dia 40/ 33 mm for use as underground cable conduits for armoured optical fibre cable.as per RDSO specn No. RDSO/SPN/TC/45/2013 Revision 2.0.	Km	60,119	10	6,01,797
11.	6 Quad 0.9 mm Jelly filled underground, Screened, Armoured Cable for Special Purpose in electrified area as per spec. No IRS TC: 30/2005 [Ver. 1] with amendment no 5 or latest amendment as on the date of opening of tender	Km	2,73,513	10	27,37,887
12.	Supply of Thermoshrinkable straight through joint suitable for making straight through/deviation joint without transformer in under ground 6 quad/jelly filled cables. RDSO Specification No. RDSO/SPN/TC/77/2010 Rev-2 or latest amendment) with all accessories.	Nos.	3,219	11	35,437
13.	Supply of VF Transformers (1 Quad/2T)	Nos.	1,330	11	14,642
14.	Supply of Emergency socket box	Nos.	5,791	11	63,700
15.	Supply of 6 pin Emergency socket .	Nos.	340	11	3,736

Bill No. 4: Telecommunication- Supply of Material					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
16.	Supply of battery charger/Power supply unit (SMPS) 230 V AC/12V DC 5 Amp. As per IRS : S :93 /96(B) rack mountable with battery	Nos.	16,214	2	32,427
	Sub-Total of Bill No. 4				**52,37,088**

Bill No. 5: Telecommunication- Installation, Testing & Commissioning					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
1	Installation and commissioning of SDH Add/Drop Multiplexers (main stream) with all accessories and power supply connection, surge and lightning protection arrangement, racks including indoor Krone box, ladder etc. in cable hut including wiring of all the equipment up to Krone / C.T. Box of out-door quad / derivation cables.	Nos.	29,448	2	58,895
2	Installation, wiring, testing & commissioning of PD MUX with all interface cards connection to 48V bus bar and termination of VF/Data interface circuits to the Krone MDF. This includes termination at both ends and taking PVC cable over runway or on the wall. This also includes supply of PVC cable of conductor size 0.63 mm & 100 pair krone type D.P Krone shall have both current & voltage protection arrangement.	Nos.	8,854	2	17,709
3	Installation of composite rack covered with front transparent doors, to house, 2 SDH, 2 OPT, MUX/OLTES and 2 PDH MUX along with PDP, DDF, cooling fans, MDF for 100 pairs with anti-surge protection through fast acting fuses and GD tubes, IPM (Z protection)	Nos.	4,240	1	4,240
4	Installation, testing & commissioning of Fibre distribution management/FTB system including accessories complete as per RDSO specification No. RDSO/SPN/TC/037-2000 (Rev 2) and splicing of fibre with pigtail cables and end to end testing of OFC cables.	Nos.	6,848	5	34,240
5	Installation, testing, wiring and commissioning of 4 wire way station equipment. Item required for installation such as wires, wiring material, connectors, equipment battery rack run way, hardware etc to be supplied by contractor.	Nos.	2,914	4	11,656

Bill No. 5: Telecommunication- Installation, Testing & Commissioning					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
6	Installation, testing & commissioning of Power supply unit/UPS. This includes all installation & wiring material etc. required.	Nos.	3,414	4	13,656
7	Installation and testing of 9 U 19" wall mounted rack for housing datacom equipment.	Nos.	1,356	3	4,068
8	"Blowing/Drawing of OFC/ Telecom cable in the HDPE duct laid in trenches & protective works "	Km	11,868	10	1,18,800
9	Laying of 6 quad cable / derivation cable /PIJF cable in the trenches and in the protective works already provided at different places as per direction of the Engineer's representative.	Km	6,454	12	74,291
10	Excavation of cable trench (Kacha) of 300mm wide and 1200mm deep for all type of soil, back filling after laying of telecom cable/ OFC in GI/HDPE pipe ramming of soil in trenches and consolidation of soil. This also includes cleaning of roots of trees and bushes & temporary construction on the selected routes. Where digging of trench of 1200mm depth or 300mm width or both is not possible as per site condition and the same can be reduced if accepted by the site engineer, the payment shall be decreased proportionately according to the volume. It shall confirm to the safe distance as per signalling/ telecom (NR/S&T/Con/1.1/97A) and cable plan.	Metre	86	11510	9,95,576
11	"Laying of HDPE duct in the trenches, including in HDD/Manual Boring portion and supply pulling of Nylon rope through it at different places as per directions of Engineer's representative	Km	7,996	10	80,037

Bill No. 5: Telecommunication- Installation, Testing & Commissioning					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
12	Installation of Thermoshrinkable jointing kits for making (a) straight through joints without transformer for 6 quad jelly filled cable, (b) Derivation joint with/without transformer of 6-Quad jelly filled cable, and (c) Straight Through joint without transformer for 10 Pair/20 Pair PIJF cables and construction of Brick Chamber for protection of joints with contractor's all materials.	Nos.	1,624	11	17,875
13	Installation, testing, wiring and commissioning of battery charger, 48 volt battery set fully charged and ultra isolation transformers. This includes all installation material/ wires etc. required for work.	Set	2,457	2	4,913
14	Supply, installation and Testing & Commissioning of maintenance free earth suitable kit as per RDSO specification RDSO/SPN/197/2008 and Drg No. SDO/RDSO/E&B/002 dated 19.9.2008 or latest with latest amendments for earth resistance of less than 1 ohm. This incudes interconnection and extending earth to equipment/ power supply room and associated wiring and protection works.	Nos.	24,760	3	6,83,585
15	Supply and installation of optical fibre cable joint enclosure as per TEC spec no. GR/OJC-02/01/March 99 (Make: Raychem or superior) with fabrication & installation of jointing pit (1 m inner dia) for OFC joint closure.	Nos.	16,007	10	1,60,072

Bill No. 5: Telecommunication- Installation, Testing & Commissioning					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
16	Supply & installation of Double walled corrugated HDPE Pipe of outer dia 120 mm (other than black in colour) (in 6m straight length with one coupler for every 6m length) conforming to BSEN-50086-2-4 for latest IS specification14930 Pt II wherever required as per approved cable route plan. This includes brick work and other arrangements required to secure the pipe as per specifications, drawings and stipulations of tender documents & as per approved cable route plan including road crossing/platform/track crossing & for bridges and culverts etc.	Metre	387	216	83,500
17	Supply and fixing of G.I. pipe 80 mm dia, 3mm thick, as per specn No. IS-1239, Medium grade, perforated at a distance of 20 CM or less of required length at culverts/ bridges/along the cuttings, suitably concreted at both ends as per drg. No. (NR/S&T/CON/1. 4/97). G.I. clamps of M.S. flats bolts & nuts to be supplied by the contractor.	Metre	925	192	1,77,676
18	Supply and laying of 2nd class bricks in the trench and laying as per drg. No.(NR/S&T/CON/1.1/97-A) as per instructions of the Engineer's representative. The bricks upto home signal shall be laid perpendicular (8-9 bricks/metre) and between home & distant longitudinal (4 bricks/metre)	Nos.	8	40000	3,10,800
19	Supply and installation of CT box with GD tubes & LD etc with disconnection facility & termination of cables as per RDSO guidelines - 20 pair	Nos.	2,464	8	19,714
20	Fabrication and erection of Emergency Rail post complete with Emergency socket box, socket termination of cable etc. This shall include all installation material required for the work. Rail post shall be supplied by the Employer and issued to the contractor for execution.	Nos.	1,817	11	19,988

Bill No. 5: Telecommunication- Installation, Testing & Commissioning					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
21	Fabrication, supply and fixing of cable marker of 1:3:6 concrete as perNo.NR/S&T/CON/1. 5/97A. The marker shall be fixed at various places of cable route as per instructions of the Engineer's Representative at site.	Nos.	277	230	63,701
	Sub-Total of Bill No. 5 (INR)				**29,54,992**

Bill No. 6: Maintenance of Signalling & Telecommunication System					
S. No.	**Item Description**	**Unit**	**Rate**	**Qty**	**Amount (INR)**
1.	Maintenance of Signalling & Telecommunication installation with all gears for each quarter	Nos.	4,72,233	4	18,88,932
				Sub-Total of Bill No. 6 (INR)	18,88,932

Note: Equipment from RDSO approved vendor shall be inspected by RDSO/RITES. Other equipment shall be inspected by Engineer's Representative.