BID DOCUMENT FOR
BALANCE WORKS OF DESIGN, SUPPLY, CONSTRUCTION, TESTING AND COMMISSIONING OF SIGNALLING, TELECOMMUNICATION AND ASSOCIATED WORKS OF DOUBLE TRACK RAILWAY LINES UNDER CONSTRUCTION ON A DESIGN BUILD LUMP SUM BASIS FOR DEEN DAYAL UPADHYAY - NEW BHAUPUR SECTION OF EASTERN DEDICATED FREIGHTCORRIDOR

SIGNALLING AND TELECOMMUNICATION WORKS
CONTRACT PACKAGE: 203(R)

Issued on: 27.08.2020

IFB No.: HQ/S&T/EC/D-B/DDU-BPUN

(Part-1)

Employer:

DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LIMITED

A GOVERNMENT OF INDIA ENTERPRISE

under

MINISTRY OF RAILWAYS

INDIA

INVITATION FOR BID
DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LIMITED

Our Ref.: Date

To

From
Managing Director,
DFCCIL
5th Floor, Supreme Court Metro Station
Building New Delhi-110001.

BALANCE WORKS OF DESIGN, SUPPLY, CONSTRUCTION, TESTING AND COMMISSIONING OF SIGNALLING, TELECOMMUNICATION AND ASSOCIATED WORKS OF DOUBLE TRACK RAILWAY LINES UNDER CONSTRUCTION ON A DESIGN BUILD LUMP SUM BASIS FOR DEEN DAYAL UPADHYAY - NEW BHAUPUR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR.

The Bid document consists of Five Parts i.e. Technical Bid in Part-1, Part-2, Part-3 & Part-4 and Financial Bid – (Part-5). The contents of these Parts are as under:

TECHNICAL BID:

PART 1 – Bidding Procedures

Section I. Instructions to Bidders
Section II. Bid Data Sheet
Section III. Evaluation and Qualification Criteria
Section IV. Bidding Forms

PART 2 – Employer's Requirements

Section V (A): General Specifications

Volume 1: Scope of Works
Volume 2: General
Volume 3: Design Procedures and Processes
Volume 4: Design Criteria and Specifications
Volume 5: Manufacturing, Supply, Installation, Testing and Commissioning
Volume 6: Appendices

Section V (B): Particular Specifications

Volume 7: Particular Specifications for Signalling works
Volume 8: Particular Specifications for Telecommunication works
Volume 9: Particular Specifications for Building & Civil Structure works

PART 3 – Conditions of Contract and Contract Forms

Section VI. General Conditions of Contract (GCC) as per FIDIC Yellow Book 1999 - Edition
Section VII. Particular Conditions of Contract (PCC)

- Appendix to Tender

Section VIII. Contract Forms

PART 4 – Reference Documents

1. SITE DATA:

a. Formation Alignment(plan & profile)

b. Yard plans

c. Building plan

2. Signal Interlocking Plans of Stations & Block Sections

FINANCIAL BID:

PART – 5 - Price Schedules (To be submitted separately)

1. Preamble
2. PRICE PROPOSAL SUBMISSION SHEET (BDF-20)
3. **Schedule – A** (Form for Lump sum cost of the Bid) with Annexure-I
4. **Schedule – B** (Form for Apportionment of contract Price for Payments of Signalling Works, Telecommunication Works and Building & Structure Works)
5. **Schedule – C** (Form for Apportionment of contract Price for Payments of Signalling Works according to Cost Centers/ Sub Cost-Centers)
6. **Schedule – D** Form for (Apportionment of contract Price for Payments of Telecommunication Works according to Cost Centers/ Sub Cost-Centers)
7. **Schedule E** – Form for (Apportionment of contract Price for Payments of Building & Structure Works according to Cost Centres/ Sub Cost-Centers)

Note: *Tenders duly filled in must be submitted at the place by the time and date as specified in the Bid Document. Late or delayed tenders shall not be accepted.*

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7. Schedule E – Form for (Apportionment of contract Price for Payments of Building & Structure Works according to Cost Centers/ Sub-Cost Centers)

PART- 1

BIDDING PROCEDURES

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Section I. Instructions to Bidders

Table of Clauses

E. Evaluation and Comparison of Bids

F. Award of Contract

Section I. Instructions to Bidders

A. General

1. Scope of Bid	1.1 In connection with the Invitation for Bids indicated in the Bid Data Sheet (BDS), the Employer, issues this Bidding Document for "**BALANCE WORKS OF DESIGN, SUPPLY, CONSTRUCTION, TESTING AND COMMISSIONING OF SIGNALLING, TELECOMMUNICATION AND ASSOCIATED WORKS OF DOUBLE TRACK RAILWAY LINES UNDER CONSTRUCTION ON A DESIGN BUILD LUMP SUM BASIS FOR DEEN DAYAL UPADHYAY - NEW BHAUPUR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR**".
	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 require otherwise, words indicating the singular also include the plural and words indicating the plural also include the singular; and c. "Day" means calendar day. 1.3 Besides the information given in the Invitation for Bids, following further information are as under: a. **Date of commencement of Works** – within **42 days** from the date of receipt of "Letter of Acceptance" or as indicated in the 'Letter of Acceptance'. b. **Period of completion** – 730 days from the date of commencement. c. **Defect Notification Periods** – Defect Notification Period shall be 24 months from the date of taking over of the Works (Sub-Clause-10.1 of GCC) and issue of taking over certificate by the Engineer
2. Source of Funds	2.1 The required funds will be arranged by the employer.
3. Fraud and Corruption	3.1 It is the Employer's Policy that bidders, Suppliers, Contractors, and their Sub-Contractors, Personnel, observe the highest

	standard of ethics during the procurement and execution of the contract[1]. 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" is the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party[2]; (ii) "fraudulent practice" is any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation[3]; (iii) "collusive practice" is an arrangement between two or more parties[4] designed to achieve an improper purpose, including to influence improperly the actions of another party; (iv) "coercive practice" is impairing or harming, or threatening to impair or harm, directly or indirectly, any party[5] or the property of the party to influence improperly the actions of a party; (v) "obstructive practice" is (aa) deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede an investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the

1 In this context, any action taken by a Bidder, supplier, contractor, or a sub-contractor to influence the procurement process or contract execution for undue advantage is improper.

2 "another party" refers to a public official acting in relation to the procurement process or contract execution]. In this context, "public official" includes employees of other organizations taking or reviewing procurement decisions.

3 a "party" refers to a public official; the terms "benefit" and "obligation" relate to the procurement process or contract execution; and the "act or omission" is intended to influence the procurement process or contract execution.

4 "parties" refers to participants in the procurement process (including public officials) attempting to establish bid prices at artificial, non-competitive levels.

5 a "party" refers to a participant in the procurement process or contract execution.

	investigation or from pursuing the investigation, or (bb) Acts intended to materially impede the exercise of the Employer's inspection and audit rights provided for under sub-clause 3.1, (d) below. (b) will reject a proposal for award if it determines that the Bidder recommended for award has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive or obstructive practices in competing for the contract in question; (c) will sanction a or individual, at any time including by publically declaring such firm or individual ineligible, either indefinitely or for a stated period of time, Employer if it at any time determines that the firm has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive or obstructive practices in competing. (d) will have the right to get the accounts, records and other documents relating to the bid submission and contract performance or the bidders, suppliers, and contractors and their sub-constructors audited by auditors appointed by the Employer.

4. Eligible Bidders	4.1 A Bidder shall be a private, public or Govt. owned legal entity or any combination of them in the form of joint venture (JV) 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) The Bidder should be an Indian firm/ Company/Entity registered in India.** **(ii) Submit Power of Attorney authorizing the signatory of the bid to commit the bidder.** b. In case of Joint Venture: i) Separate identity/name shall be given to the Joint Venture. ii) Maximum number of partners in the JV shall be limited to 4 (Four). iii) A member of JV shall not be permitted to participate either in individual capacity or as a member of another JV in the same Bid. iv) The *Bid Document* form can be purchased in the name of the Bidder/JV or lead member of JV. v) One of the members of the JV shall be its lead member who shall have majority (at least 51%) share of interest in the JV. The other members shall have a share of not less than 20% each in case of JV with up to 3 members and not less than 10% each in case of JV having more than three members. vi) In case of JV with foreign member(s), the lead member has to be an Indian firm with a minimum share of 51%. vii) Member of JV from a country may be excluded if as a matter of law or official regulations the Government of India (GOI) prohibits commercial relations with the country. viii) Joint And Several Liability - Members of the JV to which the contract is awarded, shall be jointly and severally liable to the Employer (DFCCIL) for execution of the project in accordance with General and Particular Conditions of Contract. The JV members shall also be liable jointly and severally for the loss, damages caused to the DFCCIL during the course of execution of the contract or due to non-execution of the contract or part thereof.

	ix) Duration of the Joint Venture Agreement - shall be valid during the entire currency of the contract including the period of extension, if any and the defect notification period after the work is completed. x) Governing Laws - The Joint Venture Agreement shall in all respect be governed by and interpreted in accordance with Indian Laws. xi) The JV shall nominate a representative (from lead partner only) who shall have the authority to conduct all business for and on behalf of JV during the bidding process and subsequent stages. xii) BID SECURITY shall be submitted by JV/Lead member of the JV. The BID SECURITY submitted by the Lead member shall be deemed as BID SECURITY submitted by JV Firm. xiii) A copy of Memorandum of Understanding (MOU) duly executed by the JV members on a stamp paper shall be submitted by the JV along with the Bid. The complete details of the members of the JV, their share and responsibility in the JV etc. particularly with reference to financial, technical and other obligations shall be furnished in the MOU. xiv) Once the Bid is submitted, the MOU shall not be modified / altered / terminated during the validity of the Bid. In case the Bidder fails to observe/comply with this stipulation, the full *Bid Security Deposit (BSD)* shall be liable to be forfeited. xv) Approval for change of constitution of JV shall be at the sole discretion of the Employer (DFCCIL). The constitution of the JV shall not be allowed to be modified after submission of the Bid by the JV, except when modification becomes inevitable due to succession *laws* etc., provided further that there is no change in qualification of minimum eligibility and qualification criteria by JV after change of composition. However, the Lead Member shall continue to be the Lead Member of the JV. Failure to observe this requirement would render the offer invalid. xvi) Similarly, after, the contract is awarded, the constitution of JV shall not be allowed to be altered during the currency of contract except when modification become inevitable due to succession laws etc. and minimum

	eligibility and qualification criteria should not get vitiated. Failure to observe this stipulation shall be deemed to be breach of contract with all consequential penal action as per contract conditions. xvii) On award of contract to a JV, a single Performance Guarantee shall be submitted by the JV as per Bid conditions. All the Guarantees like Performance Guarantee, Bank Guarantee for Mobilization Advance, Machinery Advance, etc. shall be accepted only in the name of the JV and no splitting of guarantees amongst the members of the JV shall be permitted. xviii) On issue of LOA (Letter Of Acceptance), the MOU/JV agreement among the members of the JV to whom the work has been awarded, with the same shareholding pattern as was declared in the MOU/JV Agreement submitted alongwith the Bid, shall be got registered before the Registrar of the Companies under 'The Companies Act-2013' (in case of Company) or before the Registrar/Sub-Registrar under 'The Indian Partnership Act, 1932 (in case of Partnership Firm) or under 'The LLP Act 2008' (in case of LLP). A separate PAN shall be obtained for this entity. The documents pertaining to this entity including its PAN shall be furnished to the DFCCIL before signing the contract agreement for the work. In case the Bidder fails to observe/comply with this stipulation within 60 days of issue of LOA, contract is liable to be terminated. In case contract is terminated the DFCCIL shall be entitled to forefeit the full amount of BID SECURITY and other dues payble to the Contractor under this contract. xix) No member of the Joint Venture shall have the right to assign or transfer the interest right or liability in the contract without the *written* consent of the other members and that of the employer (DFCCIL) in respect of the said Bid*/contract.* xx) In case one or more of the members of the JV is/are partnership firm(s), following documents shall be submitted : (a) A notarized copy of the Partnership Deed (b) A copy of consent *of* all the partners or individual authorized by partnership firm, to enter into the Joint Venture Agreement on a stamp paper.

	(c) A notarized copy of Power of Attorney in favour of the individual to sign the MOU/JV Agreement on behalf of the partnership firm and create liability against the firm. xxi) In case one or more members is/are Proprietary Firm or HUF, the following documents shall be enclosed : A copy of notarized affidavit on Stamp Paper declaring that his/her Concern is a Proprietary Concern and he/she is sole proprietor of the Concern OR he/she is in position of "KARTA" of Hindu Undivided Family (HUF) and he/she has the authority, power and consent given by other partners to act on behalf of HUF. xxii) In case one or more members of the JV is/are companies, the following documents shall be submitted: (a) A copy of resolutions of the Directors of the Company, permitting the company to enter into a JV agreement, (b) A copy of Memorandum and Articles of Association of the Company. (c) A copy of certificate of incorporation. (d) A copy of Authorization/copy of Power of Attorney issued by the Company (backed by the resolution of Board of Directors) in favour of the individual to sign the Bid, sign MOU/JV Agreement on behalf of the company and create liability against the company. 4.2 A firm that is under a declaration of ineligibility by the Employer in accordance with ITB 3, on the date of the deadline for bid submission or thereafter, shall be disqualified. 4.3 A Bidder shall not have any conflict of interest with any other party involved with the project, either as a bidder or in any other capacity during the project formulation and developmental stage. Any Bidder (s) including all members of JV 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) if they participated as a consultant in the preparation of the design or technical specifications of the Works that are the subject of this Bid.

	(b) Where a firm, or a firm from the same economic or financial group, in addition to consulting, also has the capability to manufacture or supply goods or to construct works, that firm, or a firm from the same economic or financial group, cannot normally be a supplier of goods or works, if it provided consulting services for the contract corresponding to this Bid , unless it can be demonstrated that there is not a significant degree of common ownership, influence or control. 4.4 The Bidder shall also be considered disqualified / in- eligible if (a) The Bidder or any of its partners and/or subcontractors included in the Bid has been banned for business with Ministry of Railways along with any of its attached and subordinate offices through an order issued by Ministry of Railways as per list available on Web site (http://www.indianrailways.gov.in/railwayboard) of Railway Board pertaining to Banning of Business, with the Banning being valid on the last date of submission of Bid. (b) The Bidder or any of its partners has suffered bankruptcy / insolvency or it is in the process of winding-up or there is a case of insolvency pending before any Court on the deadline of submission of Bid. 4.5 Bidders shall provide such evidence of their continued eligibility satisfactory to the Employer, as the Employer shall reasonably request.
5. Eligible Materials and Equipment	5.1 The materials and equipment to be supplied under the Contract shall be from the approved sources as specified in Part-2, Section V: Employer's Requirements. In addition to above, materials not covered under approved sources specified in Section V: Employer's Requirements, should be procured as per the approval of Employer's authorized representative/Engineer.
	B. Contents of Bidding Documents
6. Sections of Bidding Documents	6.1 The Bid Document consists of 5 Parts; Technical Bid consisting of Part-1, Part-2, Part-3 & Part-4. Financial Bid consisting of Part-5. **PART 1 Bidding Procedures** • Section I. Instructions to Bidders (ITB)

	• Section II. Bid Data Sheet (BDS) • Section III. Evaluation and Qualification Criteria • Section IV. Bidding Forms **PART 2 Employer's Requirements** Section V (A): General Specifications Volume 1: Scope of Works Volume 2: General Volume 3: Design Procedures and Processes Volume 4: Design Criteria and Specifications Volume 5: Manufacturing, Supply, Installation, Testing and Commissioning Volume 6: Appendices **Section V (B) : Particular Specifications** Volume 7: Particular Specifications for Signaling works Volume 8: Particular Specifications for Telecommunication works Volume 9: Particular Specifications for Building & Civil Structure Works **PART 3 – Conditions of Contract and Contract Forms** Section VI. General Conditions (GCC) as per FIDIC Yellow Book 1999-Edition Section VII. Particular Conditions of Contract (PCC). • Appendix to Tender Section VIII. Contract Forms **PART 4 – Reference Documents** **1. SITE DATA:** a. Formation Alignment(plan & profile) b. Yard plans c. Building plan **2. Signal Interlocking Plans of Stations & Block Sections** **FINANCIAL BID :** **PART – 5 - Price Schedules (To be submitted separately)** 1. Preamble 2. Price proposal submission sheet (BDF-20) 3. Schedule – A (Form for Lump sum cost of the Bid) with Annexure I

	4. Schedule – B (Form for Apportionment of contract Price for Payments of Signalling Works, Telecommunication Works and Building & Civil Structure Works) 5. Schedule –C (Form for Apportionment of contract Price for Payments of Signalling Works according to Cost Centers/ cost sub- centers) 6. Schedule –D (Form for Apportionment of contract Price for Payments of Telecommunication Works according to Cost Centers/ cost sub -centers) 7. Schedule E – (Form for Apportionment of contract Price for Payments of Building & Civil Structure Works according to Cost centres/cost sub-centers) The contents of all these sections listed above shall be read in conjunction with any Amendment/addenda issued in accordance with ITB-8.
	6.2 The Invitation for Bids (IFB) issued by the Employer is not part of the Bidding Document.
	6.3 Bid can be viewed from DFCCIL's website www.dfccil.com & Central Procurement portal eprocure.gov.in. Amendment(s) (if any) will be uploaded on DFCCIL website www.dfccil.com only. The bid can be submitted only on a set of bidding documents obtained directly from the Employer or downloaded from DFCCIL's website www.dfccil.com. Cost of Bid document shall be as specified in Invitation for Bids (IFB).
	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 Documents, Site Visit, Pre-Bid Meeting	7.1 A prospective Bidder requiring any clarification of the Bidding Documents shall contact the Employer in writing at the Employer's address **specified in the BDS** or raise its enquiries during the pre-bid meeting in accordance with ITB 7.4. The Employer will respond in writing to any request for clarification provided that such request is received 3 working days after pre-bid meeting. 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 23.2.

	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 himself 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. The purpose of the meeting will be to clarify issues and to answer questions related to the subject work that may be raised at that stage. The Bidder's designated representative is also invited to attend a site visit, if provided for in the BDS. The purpose of site visit will be to familiarize the Bidders with site conditions.
	7.5 The Bidder is requested to submit any questions/queries in writing, to reach the Employer not later than 3 days after the Pre-Bid meeting.
	7.6 Minutes of the pre-bid meeting, including the text of the questions/queries asked by Bidders, 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 Documents directly from the Employer. Any modification to the Bidding Documents 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/Corrigendum pursuant to ITB 8 and not through the minutes of the pre-bid meeting. 7.7 Nonattendance at the pre-bid meeting or site visit will not be a cause for disqualification of a Bidder.
8. Amendment of Bidding Documents	8.1 At any time prior to the deadline for submission of bids, the Employer may amend the Bidding Documents by issuing addenda.

	8.2 Any addendum issued shall be part of the Bidding Documents and shall be communicated in writing to all who have obtained the Bidding Documents from the Employer in accordance with ITB 6.3. This will also be uploaded on DFCCIL website www.dfccil.com. All prospective Bidders are advised to see the DFCCIL website www.dfccil.com before submitting their bid to check for any amendment/ corrigendum issued in regard to this Bid.
	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 23.2
	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 pages in English as certified by the Embassy/High Commission/ Consulate of Indian origin of the bidder or the Embassy /High Commission / Consulate of the country of origin of the bidder in India. For the purpose of interpretation and evaluation of the bid, translation certified by Embassy/High Commission/ Consulate shall prevail.
11. Documents Comprising the Bid	11.1 The Bid shall comprise two separate envelopes submitted simultaneously, one containing the **Technical Proposal and other containing the Financial Proposal**, enclosed together in an outer single envelope. 11.2 Initially, only the Technical Proposals will be opened at the address, date and time specified in **ITB Sub-Clause 26.1.** The Financial Proposals remain sealed and are held in custody by the Employer. The Technical Proposals are evaluated by the Employer. No amendments or changes to the Technical Proposals are permitted. Bids with Technical Proposals which do not conform to the specified requirements will be rejected as non-responsive Bids.

	11.3 Financial Proposals of technically compliant Bids will be opened in public at a date and time advised by the Employer. The Financial Proposals are evaluated and the Contract is awarded to the Bidder who's Bid has been determined to be the lowest evaluated substantially responsive Bid. 11.4 The Technical Proposal shall contain the following : a) Technical Proposal Submission Sheet in accordance with **ITB 15;** b) Bid Security, in accordance with **ITB 20**; c) Written confirmation authorizing the signatory of the Bid to commit the Bidder, in accordance with **ITB Clause 21.2;** d) Relevant forms as specified for establishing the eligibility and qualification criteria of the Bidder in Part -1 Section IV of the Bid document e) All the information needed in the eligibility and qualification criteria as contained in **Part-1 Section III of the Bid Document**; f) To submit the following documents 1. Undertaking to arrange minimum key personnel of requisite experience and qualification in terms of clause 2.5 as per section III , Part-1 2. Details of proposed items of equipment in terms of clause 2.6 as per section III, Part-1. 3. Method statement in terms of clause 1.2.2(1) of Annexure-I Section III, Part -1. 4. Organization chart in terms of clause 1.2.2(2) of Annexure -I Section III, Part-1. 5. Work plan in terms of clause 1.2.2(3) of Annexure-I Section III, Part-1. 6. Outline Safety plan in terms of clause 1.2.2(4) (a) of Annexure-I, Section III, Part-1. 7. Outline Quality plan in terms of clause 1.2.2(4) (b) of Annexure-I, Section III, Part-1. 8. Integrity Pact as per form BDF-17. g) Any other document required in the BDS 11.5 The Financial Proposal shall contain the following :(to be submitted separately) a) Price Proposal Submission Sheet. b) Price Schedule as per the format given in Part-5 Price Schedule of the Bid Document. c) Any other document required in the BDS.

12. Bid Submission Sheets and Price Schedules	12.1 The Bidder shall submit the Technical Proposal and the Financial Proposal using the appropriate Submission Sheets furnished in **Section IV (Bidding Forms) of the Bid Document**. 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 Financial Proposal a Lump-Sum cost for the entire work as per the format given in Schedule A of Part – 5 - Price Schedule of the Bid Document.
13. Alternative Bids	**Deleted**
14. Documents Establishing the Eligibility of the Plant and Installation Services	Deleted
15. Documents Comprising the Technical Proposal	15.1 The bidder shall furnish all the information as detailed in Technical Proposal, Section –III Evaluation and Qualification criteria of bidding document. 15.2 The Bidder shall furnish a commitment in Technical Proposal Submission Sheet (BDF-1) for deployment of equipment and personnel as stipulated in Part -1 Section –III, Evaluation and Qualification criteria.
16. Documents Establishing conformity of the Equipment and Installation Services	16.1 The Bidder shall furnish the information stipulated in Section IV, in sufficient detail to demonstrate substantial responsiveness of the Bidders' proposal to the work requirements and the completion time. 16.2 For major items listed by the Employer in Section III, Evaluation and Qualification Criteria, which the Bidder intends to purchase or subcontract, the Bidder shall give details of the name and nationality of the proposed Subcontractors, for each of those items. In addition, the Bidder shall include in its bid information establishing compliance with the requirements specified by the Employer for these items. 16.3 The Bidder shall be responsible for ensuring that any Subcontractor proposed complies with the requirements of ITB 4, and that any plant, or services to be provided by the

	Subcontractor comply with the requirements of ITB 5 and ITB 15.1
17. Bid Prices and Discounts	17.1 The bidder shall quote the lump sum cost for the entire work in Schedule A as contained in Part -5 of the Bid Document. The cost should cover all the items of the work as detailed in the employer's requirement of the contract. The cost should also be inclusive of all construction Equipment, plant, labour, supervision, materials, erection, insurance, profit, duties, taxes, levies, royalties together with all general risks, liabilities and obligations set out or implied in the Contract under the applicable law as on the date of opening of bid. 17.2 Adjustment for change in cost as given in clause 13.8 of Particular Conditions of Contract will be applicable on the Lump-sum cost of the bid with respect to the base date as defined in the GCC.
18. Currencies of Bid and Payment	18.1 The bidder shall quote a lump sum cost in Indian Rupees. Payments shall be made as per billing process laid down in Financial Bid Part-5 – Price Schedules of Bidding Document.
19. Period of Validity of Bids	19.1 Bids shall remain valid for the period **of 180 days specified in the BDS** 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. 19.2 In exceptional circumstances, prior to the expiration of the bid validity period, 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 20, it shall also be extended for sixty (60) days beyond the deadline of the extended validity period. 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.
20. Bid Security	20.1 The Bidder shall furnish as a part of its bid , a Bid Security in favour of DFCCIL, New Delhi in original form as specified in BDS. 20.2 The bid security shall be valid for period up to Ninety (90) days beyond the original validity period of the bid, or sixty (60) days beyond any period of extension if requested under ITB 19.2 whichever is later. 20.3 Any bid not accompanied by an enforceable and compliant bid security, if one is required in accordance with ITB 20.1, shall be rejected by the Employer as non-responsive. The Bid

	security of unsuccessful bidder/bidders shall be returned on award of contract. 20.4 The bid security of the successful Bidder shall be dealt as per BDS. 20.5The bid security may be forfeited: (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 19.2 or (b) if a Bidder misrepresents or omits any material the facts in order to unfairly influence the procurement process; (c) if the successful Bidder fails to: i) Sign the Contract in accordance with ITB 42; ii) Furnish a performance security in accordance with ITB 41; iii) Accept the correction of its Bid Price pursuant to ITB 32; 20.6 The Bid Security of a JV shall be as per **ITB 4.1 b(xii)** **NOTE**: No interest shall be paid by DFCCIL on Bid Security amount.
21. Format and Signing of Bid	21.1 The Bidder shall prepare one original of the Technical Proposal and one original of the Financial Proposal as described in ITB 11 and clearly mark each as "ORIGINAL - TECHNICAL PROPOSAL" and "ORIGINAL - FINANCIAL PROPOSAL". In addition, the Bidder shall submit 2 copies of the Technical Proposal and clearly mark them "COPY NO… - TECHNICAL PROPOSAL". In the event of any discrepancy between the original and the copies, the original shall prevail. In addition one soft copy (Read Only) of Technical proposal should also be submitted along with the Bid.
	21.2 The original and all copies of the bid shall be typed or written in indelible ink and shall be signed by a person duly authorized to sign on behalf of the Bidder. This authorization shall consist of a written confirmation as specified in the BDS and shall be attached to the bid. The name and position held by each person signing the authorization must be typed or printed below the signature. All pages of the bid where entries and amendments have been made shall be signed or initialed by the person signing the bid.

	21.3 Any interlineations, erasures, or overwriting shall be valid only if they are signed or initialed by the person signing the bid.
	D. Submission and Opening of Bids
22. Submission, Sealing and Marking of Bids	22.1 The Bidder shall enclose the original of the Technical Proposal, the original of the Financial Proposal, and two copies of the Technical Proposal, in separate sealed envelopes, duly marking the envelopes as "ORIGINAL - TECHNICAL PROPOSAL", "ORIGINAL - FINANCIAL PROPOSAL" and "COPY NO… - TECHNICAL PROPOSAL" , as appropriate. These envelopes containing the original and the copies shall then be enclosed in one single envelope. One single envelope containing the envelopes of Technical, Financial bids & Bid security, cost of the Bid document (if document is downloaded) shall be signed and stamped by the authority who has signed the bids otherwise. **Each copy shall be serially numbered, Indexed and hard bound.**
	22.2 The inner and outer envelopes shall: (a) bear the name and address of the Bidder; (b) be addressed to the Employer in accordance with ITB 23.1; (c) bear the specific identification (IFB No. **HQ/S&T/EC/D-B/DDU-BPUN** dated **21.08.2020)** of this bidding process indicated in accordance with ITB 1.1; (d) The outer envelopes and the inner envelopes containing the Technical Proposals shall bear a warning not to open before the time and date for the opening of Technical Proposals, in accordance with ITB Sub-Clause 26.1. (e) **The inner envelopes containing the Financial Proposals shall bear a warning not to open until advised by the Employer in accordance with ITB 26.2**
	22.3 If all envelopes are not sealed and marked as required, the Employer will assume no responsibility for the misplacement or premature opening of the bid. 22.4 In case Financial Proposal in a bid is received unsealed then the bid shall be considered as non-responsive and will not be dealt with. If, financial proposal is submitted in the technical proposal then also the bid shall be considered as non-responsive and will not be dealt with.
23. Deadline for Submission of Bids	23.1 Bids must be received by the Employer at the address and no later than the date and time indicated in the BDS.

	23.2 The Employer may, at its discretion, extend the deadline for the submission of bids by amending the Bidding Documents 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.
24. Late Bids	24.1 The Employer shall not consider any bid that arrives after the deadline for submission of bids, in accordance with **ITB 23.** Any bid received by the Employer after the deadline for submission of bids shall be declared late, rejected, and returned unopened to the Bidder.
25. Withdrawal, Substitution, and Modification of Bids	Deleted
26. Bid Opening	26.1 The Employer shall conduct the opening of Technical Proposals in the presence of Bidders' representatives who choose to attend, at the address, date and time specified in the BDS. 26.2 The financial Proposals will remain unopened and will be held in custody of the Employer until the time of opening of the Financial Proposals. The date, time, and location of the opening of Financial Proposals will be advised in writing by the Employer to all the bidders who have been determined qualified in technical evaluation. 26.3 All other envelopes holding the Technical Proposals shall be opened one at a time, and the following read out and recorded by the Employer: (a) the name of the Bidder; (b) the presence of a Bid Security, if required; and (c) any other details as the Employer may consider appropriate. 26.4 The Bidders' representatives who are present shall be requested to sign the record. The omission of a Bidder's signature on the record shall not invalidate the contents and effect of the record. 26.5 Only Technical Proposals read out and recorded at bid opening shall be considered for evaluation. No Bid shall be rejected at the opening of Technical Proposals except for late bids, in accordance with ITB 24.1. 26.6 At the end of the evaluation of the Technical Proposals, the Employer will invite bidders who have submitted substantially responsive Technical Proposals and who have been determined as being qualified for award to attend the opening of the Financial Proposals. The date, time, and location of the opening

	of Financial Proposals will be advised in writing by the Employer. Bidders shall be given reasonable notice of the opening of Financial Proposals. 26.7 The Employer shall conduct the opening of Financial Proposals of all Bidders who submitted substantially responsive Technical Proposals and who have been determined qualified as a result of technical evaluation, in the presence of Bidders`` representatives who choose to attend at the address, date and time specified by the Employer. The Bidder's representatives who are present shall be requested to sign a register evidencing their attendance. 26.8 All envelopes containing Financial Proposals shall be opened one at a time and the following read out and recorded by the Employer: (a) the name of the Bidder (b) the Bid Price(s), including any discounts (c) any other details as the Employer may consider appropriate. 26.9 The Bidders' representatives who are present shall be requested to sign the record. The omission of a Bidder's signature on the record shall not invalidate the contents and effect of the record. 26.10 Only Financial Proposals, discounts, read out and recorded during the opening of Financial Proposals shall be considered for evaluation. No Bid shall be rejected at the opening of Financial Proposals.
	E. Evaluation and Comparison of Bids
27. Confidentiality	27.1 Information relating to the examination, evaluation & comparison 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.
	27.2 Any attempt by a Bidder to influence the Employer in the examination, evaluation & comparison of the Bids or Contract award decisions may result in the rejection of its Bid. 27.3 Notwithstanding ITB 28.2, from the time of opening the Technical Proposal 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.
28. Clarification of Bids	28.1 To assist in the examination, evaluation & comparison of the Bids, and qualification of the Bidders, 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, except to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the Financial Proposals, in accordance with ITB 32. 28.2 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.
29. Deviations, Reservations and Omissions	29.1 During the evaluation of bids, the following definitions apply: (a) "Deviation" is a departure from the requirements specified in the Bidding Documents; (b) "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Bidding Documents; and (c) "Omission" is the failure to submit part or all of the information or documentation required in the Bidding Documents.
30. Determination of Responsiveness	30.1 The Employer's determination of a bid's responsiveness is to be based on the contents of the bid itself, as defined in ITB-11. 30.2 A substantially responsive bid is one that meets the requirements of the Bidding Documents 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 Documents, 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.

	30.3 The Employer shall examine the technical aspects of the bid submitted in accordance with ITB 15, Technical Proposal, in particular, to confirm that all requirements of Part -1 Section III (Evaluation and Qualification criteria) have been met without any material deviation or reservation, or omission. 30.4 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. The Employer's decision in this connection shall be final and binding.
31. Nonmaterial Nonconformities	31.1 Provided that a bid is substantially responsive, the Employer may waive any nonconformity in the bid that does not constitute a material deviation, reservation or omission. 31.2 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. 31.3 Provided that a bid is substantially responsive, the Employer shall rectify quantifiable nonmaterial nonconformities related to the Bid Price. To this effect, the Bid Price shall be adjusted, for comparison purposes only, to reflect the price of a missing or non-conforming item or component. The adjustment shall be made using the method indicated in Section III, Evaluation and Qualification Criteria.
32. Correction of Arithmatical Errors	32.1 Provided that the bid is substantially responsive, the Employer shall correct arithmetical errors as under: If there is a discrepancy between words and figures, the amount in words shall prevail. 32.2 If the Bidder that submitted the lowest evaluated bid does not accept the correction of errors, its bid shall be disqualified and its bid security may be forfeited.
33. Conversion to Single Currency	Deleted.
34. Margin of Preference	Deleted.
35. Evaluation of Bids	35(a) **Evaluation of Technical Bids**

	35(a).1 The Employer shall determine to its satisfaction during the evaluation of Technical Proposals whether Bidders are qualified to perform the Contract satisfactorily. 35(a).2 The determination shall be based upon an examination of the documentary evidence of the Technical Proposal submitted by the Bidder, pursuant to ITB 15, to clarifications in accordance with ITB 28 and the qualification criteria indicated in Part-1 Section-III, Evaluation and Qualification Criteria. 35(a).3 The Employer will carry out a detailed evaluation of the technical proposals in order to determine whether the technical aspects are in compliance with the Bidding Document. In order to reach such a determination, the Employer will examine and compare the technical proposals on the basis of the information supplied by the bidders, taking into account overall completeness and compliance with the Employer's Requirements and the technical merits; 35(a).4 An affirmative determination shall be a prerequisite for the opening and evaluation of a Bidder's Financial Proposal. A negative determination shall result into the disqualification of the Bid, in which event the Employer shall return the unopened Financial Proposal to the Bidder. 35(a).5 If the bidder proposes to engage any subcontractors for major items of supply or services as listed by the Employer in Section III, Evaluation and Qualification Criteria, which the Bidder intends to purchase or subcontract, the Bidder shall give details of the name and nationality of the proposed Subcontractors, including manufacturers, for each of those items. In addition, the Bidder shall include in its bid information establishing compliance with the requirements specified by the Employer for these items. Quoted rates and prices will be deemed to apply to whichever Subcontractor is appointed, and no adjustment of the rates and prices will be permitted. 35(b) **Evaluation of Financial Bids** 35(b).1 The Employer shall evaluate Financial Proposals of each Bid for which the Technical Proposals have been determined to be substantially responsive as per evaluation criteria given in Part – 1 Section-III, of the Bid Document. 35(b).2 To evaluate the financial proposal of a bid, the Employer shall consider the following:

	i) Total lump sum bid price; ii) Discounts offered if any. 35(b).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.
36. Comparison of Bids	36.1 The Employer shall compare all substantially responsive bids to determinethe lowest evaluated bid, in accordance with **ITB 35(b)**.
37. Eligibility and Qualifications of the Bidder	37.1 As per relevant provision in ITB, BDS and Section III, Part 1, Evaluation and qualification criteria.
38. Employer's Right to Accept Any Bid, and to Reject Any or All Bids	38.1 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 returned to the Bidders.
	F. Award of Contract
39. Award Criteria	39.1 Subject to ITB 38.1, the employer shall award the contract to the bidder who's offer has been determined to be lowest evaluated bid and is substantially responsive to the bid document, provided further that the bidder is dertermined to be eligible and qualified to perform the contract satisfactorly.
40. Notification of Award	40.1 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. 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. 40.2 Until a formal contract is prepared and executed, the notification of award shall constitute a binding Contract.
41. Performance Security	41.1 Within Twenty Eight (28) days of the receipt of Letter of Acceptance from the Employer, the successful Bidder shall furnish the performance security in accordance with the conditions of contract, using for that purpose the Performance

	Security Form included in Part-3, Section VIII: Contract Forms of Bid Document or another form acceptable to the Employer. 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.
42. Signing of Contract	42.1 After notification and submission of performance security, the Employer shall send the successful Bidder the Contract Agreement. 42.2 Within Thirty (30) days of receipt of the Contract Agreement, the successful Bidder shall sign, date, and return it to the Employer.
43. Integrity Pact	43.1 As per office memorandum no F.No DPE/13(12)/11-Fin Dated 09.09.2011 issued by Ministry of Heavy Industries (DPE) all PSU should enter into Integrity pact in the required proforma in their procurement transaction/ Contracts with suitable changes specific to the situation in which the pact is to be used. The pact, entering into which would be a preliminary qualification for any bidder, essentially envisages an agreement between the prospective vendors / bidders and the DFCCIL, committing the persons/ officials on both sides not to resort to any corrupt practices in any aspect / stage of the contract. A copy of pre contract integrity pact is enclosed as BDF 17 for signature of bidder as acceptance. The details of Independent External monitor (IEM) shall be collected from the office of CGM/DFCCIL/ALD(W) whenever required.
44. System for verification of Bidder Credentials	44.1. For the works contracts, it has been decided to adopt the affidavit-based system of credential verification. The bidder shall submit along with bidding document, document in support of his/their claim to fulfill the eligibility and qualification criteria as mentioned in the bid document. Each page of the copy of document/certificates in support of certificates submitted by the bidder, shall be notarized. 44.2. The bidders shall submit a notarized affidavit on a non-judicial stamp paper stating that they are not liable to be disqualified and all their statements/documents submitted along with bid are true and factual. Standard format of the affidavit to be submitted by the bidder is enclosed as BDF-18. Non submission of an affidavit by the bidder shall result in summary rejection of his/their bid. And it shall be mandatorily incumbent upon the bidder to identify, state and submit the supporting documents duly notarized by which they/he is

	qualifying the Qualifying Criteria mentioned in the Bid Document. It will not be obligatory on the part of Tender Committee to scrutinize beyond the submitted document of tenderer as far as his qualification for the tender is concerned. 44.3. The DFCCIL reserves the right to verify all statements, information and documents submitted by the bidder in his tender offer, and the bidder shall, when so required by the DFCCIL, make available all such verification. Any such verification or lack of such verification, by the DFCCIL shall not relieve the bidder of its obligations or liabilities hereunder nor will it affect any right of the DFCCIL thereunder. 44.4. In case of any wrong information submitted by bidder the contract shall be terminated, Bid Security Deposit and Performance Security of Contract forfeited and agency barred for doing business on entire DFCCIL for 5(five) years.
45. Participation of Partnership Firms in works contracts	45.1 The Partnership Firms participating in the bid should be legally valid under the provisions of the Indian Partnership Act. 45.2 The partnership firm should have been in existence or should have been formed prior to submission of bid. Partnership firm should have either been registered with the Registrar or the partnership deed should have been notarized prior to date of bid opening as per the Indian Partnership Act. 45.3 Separate identity / name should be given to the partnership firm. The partnership firm should have PAN / TAN number in its own name and PAN / TAN number in the name of any of the constituent partners shall not be considered. The valid constituents of the firm shall be called partners. 45.4 Once the bid has been submitted, the constitution of the firm shall not normally be allowed to be modified / altered / terminated during the validity of the bid as well as the currency of the contract except when modification becomes inevitable due to succession laws etc., in which case prior permission should be taken from DFCCIL and in any case the minimum eligibility and qualification criteria should not get vitiated. The re-constitution of firm in such cases should be followed by a notary certified Supplementary Deed. The approval for change of constitution of the firm, in any case, shall be at the sole discretion of the DFCCIL and the bidder shall have no claims what-so-ever. Any change in the constitution of Partnership firm after opening of bid shall be with the consent of all partners and with the signatures of all partners as that in the Partnership Deed. Failure to observe this requirement shall render the offer invalid and full bid security shall be forfeited.

	If any Partner/s withdraws from the firm after opening of the bid and before the award of the contract, the offer shall be rejected and bid security of the bidder will be forfeited. If any new partner joins the firm after opening of bid but prior to award of contract, his / her credentials shall not qualify for consideration towards eligibility and qualification criteria either individually or in proportion to his share in the previous firm. In case the bidder fails to inform DFCCIL beforehand about any such changes / modification in the constitution which is inevitable due to succession laws etc. And the contract is awarded to such firm, then it will be considered a breach of the contract conditions liable for determination of the contract under Clause 15.2 of GCC. 45.5 A partner of the firm shall not be permitted to participate either in his individual capacity or as a partner of any other firm in the same bid. 45.6 The bid form shall be submitted only in the name of partnership firm. The bid security shall be deposited by partnership firm through e-payment gateway or as mentioned in bid document. The bid security submitted in the name of any individual partner or in the name of authorized partner (s) shall not be considered. 45.7 One or more of the partners of the firm or any other person (s) shall be designated as the authorized person (s) on behalf of the firm, who will be authorized by all the partners to act on behalf of the firm through a "Power of Attorney", specially authorizing him / them to submit & sign the bid, sign the agreement, receive payment, witness measurements, sign measurement books, make correspondences, compromise / settle / relinquish any claim (s) preferred by the firm, sign "No Claim Certificate", refer all or any dispute to arbitration and to take similar such action in respect of the said bid / contract. Such "Power of Attorney" shall be notarized / registered and submitted along with the bid. 45.8 On issue of Letter of Acceptance (LOA) to the partnership firm, all the guarantees like Performance Guarantee, Guarantee for various Advances to the Contractor shall be submitted only in the name of the partnership firm and no splitting of guarantees among the partners shall be acceptable. 45.9 On issue of Letter of Acceptance (LOA), contract agreement with partnership firm shall be executed in the name of the firm only and not in the name of any individual partner. 45.10 In case the Letter of Acceptance (LOA) is issued to a partnership firm, the following undertakings shall be furnished

	by all the partners through a notarized affidavit, before signing of contract agreement. (a) Joint and several liabilities: The partners of the firm to which the Letter of Acceptance (LOA) is issued, shall be jointly and severally liable to the DFCCIL for execution of the contract in accordance with General and Particular Conditions of the Contract. The partners shall also be liable jointly and severally for the loss, damages caused to the DFCCIL during the course of execution of the contract or due to non-execution of the contract or part thereof (b) Duration of the partnership deed and partnership firm agreement: The partnership deed/partnership firm agreement shall normally not be modified/altered/ terminated during the currency of contract and the maintenance period after the work is completed as contemplated in the conditions of the contract. Any change carried out by partners in the constitution of the firm without permission of DFCCIL, shall constitute a breach of the contract, liable for determination of the contract under Clause 15.2 of the General Conditions of Contract. (c) Governing laws: The partnership firm agreement shall in all respect be governed by and interpreted in accordance with the Indian laws. (d) No partner of the firm shall have the right to assign or transfer the interest right or liability in the contract without the written consent of the other partner/s and that of the DFCCIL. 45.11 The bidder shall clearly specify that the bid is submitted on behalf of a partnership firm. The following documents shall be submitted by the partnership firm, with the bid: (i) A notarized copy of partnership deed. (ii) A notarized or registered copy of Power of Attorney in favour of the individual to tender for the work, sign the agreement etc. and create liability against the firm. (iii) An undertaking by all partners of the partnership firm that they are not blacklisted or debarred for business with Ministry of Railways along with any of its attached and subordinate offices through an order issued by Ministry of Railways as per list available on Web site (http://www.indianrailways.gov.in/railwayboard) of Railway Board pertaining to Banning of Business, with the Banning being valid on the last date of submission of Bid. Concealment / wrong information in regard to above shall make the contract liable for determination

	under Clause 15.2 of the General Conditions of Contract. (iv) All other documents in terms of ITB 11. 45.12 In case the Bidder is a partnership firm, the construction experience and contractual payments received shall be in the name of partnership firm only.
46. Provisions regarding GFR 2017	46.1 Any bidder from a country which shares a land border with India will be eligible to bid in this tender only if the bidder is registered with the Competent Authority. 46.2 "Bidder" (including the term 'tenderer'. 'consultant' or 'service provider' in certain contexts) means any person or firm or company, including any member of consortium or joint venture (that is an association of several persons, or firms or companies), every artificial juridical person not falling in any of the descriptions of bidders stated hereinbefore, including any agency branch or office controlled by such person, participating in a procurement process. 46.3 "Bidder from a country which shares a land border with India" for the purpose of this Order means. a. An entity incorporated, established Or registered in such a country; or b. A subsidiary of an entity incorporated, established or registered in such a Country; or c. An entity substantially controlled through entities incorporated, established or registered in such a country; or d. An entity whose beneficial owner situated in such a country; or e. An lndian (or other) agent of such an entity, or f. A natural person who is a citizen of a such a country; or g. A consortium or joint venture where any member of the consortium or joint venture falls under any of the above 46.4 The beneficial owner for the purpose of 46.3 above will be as under: 1. 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 per cent.

	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 decisions including by virtue of their shareholding or management rights or shareholders agreements or voting agreements; 2. In case of partnership firm, the beneficial owner is the natural persons (s) who, whether acting alone or together, or through one or more juridical person, has ownership of entitlement to more than fifteen percent of capital or profits of the partnership. 3. In case of an unincorporated association of 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 or entitlement to more than fifteen percent of the property or capital or profits of such association or body of individuals; 4. Where no natural persons is identified under (1) or (2) or (3) above, the beneficial owner is the relevant natural person who holds the position of senior managing official. 5. 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. 46.5 An Agent is a person employed to do any act for another, or to represent another in dealings with third person. 46.6 The successful bidder shall not be allowed to sub-contract works to any sub-contractor/vendor/supplier from a country which shares a land border with India unless such contractor is registered with the Competent Authority. 46.7 The Bidder shall submit the certificate as per BDF-19 in this connection. Note: The bidder may refer the guidelines in above connection issued by Government of India from time to time.

Section II. Bid Data Sheet

A General

B Contents of Bidding Document, Site Visit, Pre-bid Meeting

C Preparation of Bids

D Submission and Opening of Bids

Section II. Bid Data Sheet

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 (IFB) is: **HQ/S&T/EC/D-B/DDU-BPUN**
ITB 1.1	The Employer is: Dedicated Freight Corridor Corporation of India Limited (DFCCIL) , NEW DELHI
ITB 1.1	The name of the **IFB** is: **BALANCE WORKS OF DESIGN, SUPPLY, CONSTRUCTION, TESTING AND COMMISSIONING OF SIGNALLING, TELECOMMUNICATION AND ASSOCIATED WORKS OF DOUBLE TRACK RAILWAY LINES UNDER CONSTRUCTION ON A DESIGN BUILD LUMP SUM BASIS FOR DEEN DAYAL UPADHYAY - NEW BHAUPUR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR**.
B. Contents of Bidding Documents, Site Visit, Pre-bid Meeting	
ITB 7.1	All communication between the Employer and the Bidder shall be in writing. For the purposes of seeking clarification, the Employer's address is: **Prior to the award of contract**. Attention: Mr. Satish Kumar Designation: Group General Manager/S&T-I/EC Address : **Dedicated Freight Corridor Corporation of India Limited** Room # 402B, 4th Floor, Supreme Court Metro Station Building Complex, New Delhi -110001, India. Email: satishkumar@dfcc.co.in Telephone: (011) 23454860 Facsimile number (011) 23454701
ITB 7.4	**Pre Bid Meeting**: A pre-Bid meeting will be held to clarify the issues related to this Bid document on the date, time and venue as indicated below. All interested Bidders may attend the Pre-Bid Meeting. DFCCIL's response to queries as well as addenda to bidding document will be posted on the DFCCIL's website. Nonattendance at the pre-bid meeting will not be a cause for disqualification of a Bidder. **Date: 15.09.2020 Time: 1500 hrs.** Venue: Conference Room, Dedicated Freight Corridor Corporation of India Limited, 4th Floor, Supreme Court Metro Station Building Complex, New Delhi-110001. Website of DFCC : www.dfccil.com **Site Visit:** A site visit will be held to familiarize the Bidders with site conditions on date, time and venue as indicated below. All interested Bidders

	may attend the site visit. Nonattendance of site visit will not be a cause for disqualification of a Bidder. Date: 09.09.2020 and 10.09.2020 **For site visit**: Contact Mr. Omprakash, CGM/ALD/E/DFCCIL, 2nd floor, DFCCIL Operation control Center, Subedarganj (Opposite IOCL campus), Allahabad- 211012 Phone No.: (0532) 2287610 Email: omprakash@dfcc.co.in The Bidders are requested to come to Station Director's Room at platform 2 of DDU station on 09.09.2020 for site inspection of DDU-New Bhaupur section by train. Maximum 2 officials for each Bidder shall be permitted. The Bidders may give details of officials to CGM/ALD/E.
C. Preparation of Bids	
ITB 12.2	The prices quoted by the Bidder shall be adjustable in accordance with the provisions in Sub Clause 13.8 of Particular Conditions of Contract.
ITB 19.1	The bid validity period of bids shall be **180 (One hundred and Eighty only)** days.
ITB 20.1	The bidder should submit along with the bid, a bid security of INR 5.2 crore (Rupees Five Crore Twenty Lakhs) in favour of "Dedicated Freight Corridor Corporation of India Ltd., New Delhi" in **any** of the following forms: (i) The bid security shall be deposited in DFCClL's Bank Account as mentioned below Through net banking or payment gateway on or before schedule date and time of submission of tender. Name of Account: Dedicated Freight Corridor Corporation of India Ltd Name of Bank: Union Bank of India, Moti Bagh Branch, New Delhi-110066 Account No.- 356101010200796 Type of Account: Current IFSC Code: UBIN0S46836 **Or**, (ii) The bid security shall be submitted in favour of Dedicated Freight Corridor Corporation of India Ltd in the form of FDR/Banker's Cheque /Demand draft from Nationalised/indian Scheduled Commercial Bank, **Or,** (iii) FDR/Banker's Cheque /Demand draft/Net Banking/Payment Gateway for Rs. 30 Lakh and Bank Guarantee on format (BDF-10) from Nationalised/ Indian Scheduled Commercial Bank for the balance amount.

	Bank guarantees shall remain valid for 90 days beyond the validity of the bid. Note: Details of above shall be submitted with Technical proposal.
ITB 20.4	The bid security of the successful Bidder submitted in the form of Bank Guarantee shall be returned on Execution of contract Agreement and submission of Performance Guarantee.
ITB 21.2	The written confirmation of authorization to sign on behalf of the Bidder shall consist of: In case of Companies • Power of Attorney authorizing the signatory of the bid to commit the bidder In case of Joint Venture • Power of Attorney for Authorized Signatory of Joint Venture. In case of Partnership Firm • Power of Attorney for Authorized Signatory of Partnership Firm.
D. Submission and Opening of Bids	
ITB 23.1	Tender Box for submission of Bid shall remain open: From **10:00 Hrs to 17:00 Hrs on all working days from 29.08.2020 to 13.10.2020 and on 14.10.2020 upto 1500 Hrs** at the address given below: Office of Group General Managser/S&T-I/EC, Dedicated Freight Corridor Corporation of India Limited Room No. 402B, 4th Floor, Supreme Court Metro Station Building Complex, New Delhi - 110001, India
ITB 26.1	The Technical bid opening shall take place at: Dedicated Freight Corridor Corporation of India Limited, Conference Hall, 4th Floor, Supreme Court Metro Station Building Complex, New Delhi-110001, India **Technical Bid Opening**: **Date: 14.10.2020 Time: 1530 hrs.**

Section III Evaluation and Qualification Criteria

1. Evaluation

This section contains all the criteria that the Employer shall use to evaluate bids and qualify Bidders in accordance with ITB 30, ITB 35 and ITB 36 of Part-1, Section-I. The Bidder shall provide all the information requested in this section as well as in the forms included in Part 1 Section IV, Bidding Forms of the Bid Document.

1.1 Technical Evaluation

The documents required for submission and evaluation of Technical Proposal are detailed in Annexure-I of this section.

1.2 Economic Evaluation

The evaluation of the financial bid shall be carried out in accordance with the provisions of ITB 35. Bidders shall submit financial Bid as per the Form BDF-20, Price Proposal submission sheet as given in Part-5 of the Bidding Document.

1.3 Time Schedule:

The designated period for the completion and taking over the entire Works shall be 730 days (Seven hundred thirty days) from the Commencement Date, as indicated with further details in Para 8.2 of GCC. Bidders shall confirm that their Technical Proposals and Financial proposal are based on this Time Schedule for Completion. No credit of any kind will be given in the evaluation of Technical Proposals and Financial proposals, to a Proposal and/ or a Bid offering to complete the Works earlier than this designated period for evaluation. However, Technical Proposals and Financial Bids offering to complete the Works later than this designated period shall be rejected by the Employer.

2. Qualification

Factor	2.1 Eligibility				
Sub-Factor	Criteria				Documentation Required
	Requirement	Bidder			
		Single Entity	Joint Venture		
			All partners combined	Each partner	
2.1.1 Nationality	Nationality in accordance with ITB 4.1.	Must meet requirement	Existing or intended JVA must meet requirement	Must meet requirement	Form BDF-1and 2, with attachments
2.1.2 Conflict of Interest	No-conflicts of interests as described in ITB 4.3.	Must meet requirement	Existing or intended JVA must meet requirement	Must meet requirement	BDF-1
2.1.3 Ineligibility	Not having been declared ineligible by the Employer, as described in ITB 4.2 & 4.4.	Must meet requirement	Existing or intended JVA must meet requirement	Must meet requirement	BDF-1
2.1.4 GFR 2017 Provisions	Compliance to provisions of GFR 2017, as described in ITB 46.	Must meet requirement	Existing or intended JVA must meet requirement	Must meet requirement	BDF-19

Note: Provisions of 2.1.4 above shall be applicable to sub contractor also.

Factor	2.2 Financial Eligibility Criteria			
Sub-Factor	Criteria			Documentation Required
	Requirement	Bidder		
		Single Entity	Joint Venture	
2.2.1 Financial Eligibility Criteria	The contractual payments received by the bidder / JV firm or the arithmetic sum of contractual payments received by all the members of the JV firm in the **previous three financial year and the current financial year** up to the date of invitation of bid shall be at least **INR 782 Crores** (Rupees Seven Hundred Eighty Two Crores). **Note**: Contractual payment received by a Member in an earlier JV Firm shall be reckoned only to the extent of the concerned member's share in that JV Firm for the purpose of satisfying compliance of the above mentioned financial eligibility criteria in tender under consideration"	Must meet requirement	Must meet requirement	Form BDF-12

Factor	2.3 Experience			
Sub-Factor	Criteria			Documentation Required
	Requirement	Bidder		
		Single Entity	Joint Venture	
2.3.1 (a) Specific Experience	(i) The bidder/JV Firm or any member of the JV firm must have substantially completed in the last Ten previous financial years and the current financial year up to the date of invitation of Bid at least one single work for a minimum value of **INR 183 Cr**. (One Hundred Eighty Three Crore) and involving all components mentioned below:- a) Signalling works on Railway/ Metro Rail/ Suburban Rail transit system. b) Telecommunication works on Railway/ Metro Rail/ Suburban Rail transit system. c) Civil/Building/Structure works. OR (ii) The bidder/JV firm or any member of the JV firm must have substantially completed following works in the last Ten previous financial years and the current financial year up to the date of invitation of bid:-	Must meet the requirement Must meet the	Existing JV - Must Meet requirement Or Any Member of proposed JV - Must Meet Requirement	Form BDF-13 Form BDF-13

	a) At least one contract having value of at least **INR 146 Cr.** (One Hundred Forty Six Crore) of Signalling works on Railways/ Metro Rail/Suburban Rail transit systems **And** b) At least one contract having value of at least **INR 32 Cr.** (Thirty Two Crore) of Telecommunication works on Railways/ Metro Rail/Suburban Rail transit systems. **And** c) At least one contract having value of at least **INR 5 Cr.** (Five Crore) of Civil/ Building/Structure works. **And** d) Aggregate value as a resultant of above (a), (b) and (c) must be at least **INR 183 Crore**. **Note**: 1. Value of a completed work done by a Member in an earlier JV Firm shall be reckoned only to the extent of the concerned member's share in that JV Firm for the purpose of satisfying his/her compliance of the above mentioned technical eligibility criteria in tender under consideration. 2. The contract having components of (ii)a, (ii)b and	requirement Must meet the requirement Must meet the requirement	Existing JV - Must Meet requirement Or Any Member of proposed JV - Must Meet Requirement Existing JV - Must Meet requirement Or Any Member of proposed JV - Must Meet Requirement Existing JV - Must Meet requirement Or Any Member of proposed JV - Must Meet Requirement	Form BDF-13 Form BDF-13

	(ii)c above can be separate contracts for each component or a contract comprising one or more components. 3. In case of composite works contract, work must comprise different components for minimum values given in (ii)a, (ii)b and (ii)c above, for satisfying the eligibility criteria (ii) above			
2.3.1 (b) Specific Experience	The bidder/JV firm or any member of the JV firm or Specialized Sub-contractor must have substantially completed in the last Ten previous financial years and the current financial year up to the date of invitation of bid at least one contract having value of at least **INR 9 Cr.** (Nine Crore) involving Train Management System (TMS)/ Centralized Train Control system (CTCS) on Railway/ Metro Rail/ Suburban Rail transit system. **Note**:- 1. Contracts where the JV member/ Specialized sub-contractor was an OEM and designed, Manufactured, tested and commissioned Train Management System (TMS)/Centralized Train Control system (CTCS) based system will also be considered. 2. In case of composite work the value of work mentioned above shall only be considered for satisfying this criteria. 3. Value of a completed work done by a Member in an earlier JV Firm shall be reckoned only to the	Must meet requirements Or Can be a specialized sub-contractor	Existing JV Must meet requirements Or Any member of proposed JV must meet requirement Or Can be a specialized sub-contractor	Form BDF-14

	extent of the concerned member's share in that JV Firm for the purpose of satisfying his/her compliance of the above mentioned technical eligibility criteria in tender under consideration.			
2.3.1 (c) Specific Experience	Each JV member must have substantially completed during the last Ten financial years and the current financial year up to the date of invitation of bid:- a) At least one contract having value of at least **INR 42 Cr.** (Forty Two Crore) of Signalling works on Railways/ Metro Rail/Suburban Rail transit systems. **Or** b) At least **one contract having value of at least INR 9 Cr. (Nine Crore) of Telecommunication works on Railways/ Metro Rail/Suburban Rail transit systems.** **Or** **c) At least one contract having value of at least INR 1.2 Cr.** (One Crore Fifty Lacs) of Civil/Building/Structure works. **Note**: 1. Value of a completed work done by a Member in an earlier JV Firm shall be reckoned only to the extent of the concerned member's share in that JV Firm for the purpose of satisfying his/her	NA	Each member of proposed JV must meet requirement	Form BDF-15

	compliance of the above mentioned technical eligibility criteria in tender under consideration. 2. In case of composite work the value of above mentioned component shall only be considered for satisfying this criteria. 3. The contract having above components of (a), (b) or (c) above can be separate contracts or contracts comprising one or more components.			

Factor	**2.4 Experience**			
Sub-Factor	**Criteria**			**Documentation Required**
	Requirement	**Bidder**		
		Single Entity	**Joint Venture**	
2.4 Design Experience	The bidder/JV firms or any member of the JV firms or specialized sub-contractor must have completed the following key activities as a design consultant or in-house designer in the last Ten previous financial years and the current financial year up to the date of invitation of bid: Design of Signalling System for Stations and Automatic Signalling in Block Sections with Electronic Interlocking, Track vacancy Detection, Signals and Point Machines for at least 04 (four) Stations and 04 (four) Block Sections on any Railway/Metro Railway/Suburban Rail Transit System.	Must meet requirement Or Can be a specialized sub-contractor	Existing JV Must meet requirement Or Any member must meet requirement Or Can be a specialized sub-contractor	Form BDF-16

	Note:- 1. Contracts where the JV member/Specililzed sub-contractor was an OEM and designed, Manufactured, tested and commissioned Train Management System (TMS)/Centralized Train Control system (CTCS) based system will also be considered. 2. In case of composite work the no. of Stations/Block Sections of work mentioned above shall only be considered for satisfying this criteria. 3. Value of a completed work done by a Member in an earlier JV Firm shall be reckoned only to the extent of the concerned member's share in that JV Firm for the purpose of satisfying his/her compliance of the above mentioned technical eligibility criteria in tender under consideration.			

Note: Substantially completed works are those work which have been completed 80% or more of the latest contract value

General Notes:

(1) In Case of payment received in foreign currency, the Bidder shall state monetory amount, Bidder should indicate the INR equivalent using rate of exchange determined as follows:

For construction turnover or financial data required for each year - Exchange rate prevailing on the last day of the respective financial year (in which the amounts for that year is to be converted).

Value of one work – Exchange rate prevailing on the date of the contract.

(2) For the purpose of conversion of foreign currency to Indian Rupees (INR), the Bidders shall use the reference rates of foreign currency published by Reserve Bank of India (available on website www.rbi.org.in). In case a particular currency is not published by Reserve Bank of India, then the selling rate of the currency shall be taken from the web site-http://www.oanda.com or http://www.xe.com.

(3) Bidders while identifying the proposed specialized sub-contractors shall suggest name of only one sub-contractor instead of multiple sub-contractors for similar acitivity.

(4) (i) Following components of the work shall be considered for determination of a Joint Venture (JV):

a) Signaling Works on Railway/Metro Rail /Suburban rail transit system.

b) Telecommunication Works on Railway/Metro Rail /Suburban rail transit system.

c) Civil/Building/Structure works.

(ii) However, specialized sub-contractors are permitted in the following components /activities of work:

a) Train Management System (TMS) works on Railway/ Metro Rail/Suburban rail transit system.

b) Designing of signalling system involving electronic interlocking and automatic block signalling on Railway/Metro Rail/Suburban rail transit system.

(5) In support of Form BDF-12 (Section IV) against eligibility criteria 2.2 the Bidders must submit:

- Certificate from client showing the details of payment received in a particular financial year, duly attested by Notary.
  and/or
- TDS certificate/the audited balance sheets and/or Photostat of TDS certificates/the audited balance sheets clearly indicating the contractual amount received.

- All documents, either original copy or Photostat should be duly attested by Notary.

(6) For Forms BDF-13, BDF-14, BDF-15& BDF-16 (Section IV)

- Self -declared quantities/values are not acceptable.

- The Bidder shall submit the work done certificates from the client(s) and/or Photostat of original certificates of client (s). All documents, either original copy or photocopy should be duly attested by Notary.

- Work experience certificate from private individual shall not be considered. However, in addition to work experience certificates issued by any Govt. Organization, work experience certificate issued by Public listed company having average annual turnover of Rs.500 crore and above in last 3 financial years excluding the current financial year, lilsted on National Stock Exchange or Bombay Stock Exchange, incorporated/registered at least 5 years prior to the date of opening of tender, shall also be considered provided the work experience certificate has been issued by a person authorized by the Public listed company to issue such certificates.

- In case bidder submits work experience certificate issued by public listed company, the bidder shall also submit along with work experience certificate, the relevant copy of work order, bill of quantities, bill wise detaisl of payment received duly certified by Charted Accoutant, TDS certficates for all payments received and coopy of final/last bill paid by company in support of above work experience certificate.

- For Financial eligibility criteria the bidders shall submit certificates which may be un-attested certificate from the concerned department /client or Audited Balance Sheet duly certify by the Charted Accoutant/Certficate from Charted Accountant duly supported by Audited Balance Sheet. Client certificate from other than Govt.

organization should be duly supported by Form 16A/26AS generated through TRACES of Inocme Tax Department of India.

- No./Value/Length of a completed work done by a member in an earlier JV firm shall be reckoned only to the extent of the concerned member's share in that JV firm for the purpose of satisfying his/her compliance to the technical eligibility criteria in the tender under consideration.

(7) Contractual payment received by a member in an earlier JV firm shall be reckoned only to the extent of the concerned member's share in that JV firm for the purpose of satisfying compliance of the financial eligibility criteria in tender under consideration.

(8) In case the Bidder is a partnership firm, the construction experience and contractual payments received shall be in the name of partnership firm only.

2.5 Personnel

The Bidder shall give an undertaking to arrange the following minimum key personnel of requisite experience and qualification (minimum graduate in relevant field) during the execution of the work in addition to semi-skilled and skilled staff.

SN	Key Position	Minimum Qualifying Requirement		
		Total Work Experience (years)	Experience in Similar Works (years)	Minimum Education Qualification
1.	Project Director** (Signalling & Telecommunication)	20	7	B.E. (Electrical / Electronics)
2.	Sr. Design Engineer (Signalling)	15	5	B.E. (Electrical / Electronics)
3.	Sr. Design Engineer * (Telecommunication)	15	5	B.E. (Electronics / Telecommunication)

SN	Key Position	Minimum Qualifying Requirement		
		Total Work Experience (years)	Experience in Similar Works (years)	Minimum Education Qualification
4.	System Integrator*	15	5**	B.E. (Electrical / Electronics)
5.	Interface Manager	15	7	B.E. (Civil / Electrical / Electronics / Telecommunication)
6.	Project Manager (Signalling)	15	5	B.E. (Electrical / Electronics)
7.	Project Manager * (Telecommunication)	15	5	B.E. (Electrical / Electronics / Telecommunication)
8.	Planner & Scheduler	15	5	B. Tech. or any other Science Graduate (should be well conversant with Primavera or similar software)
9.	Quality Control Expert	15	5	B.E. (Electrical / Electronics)
10.	Systems Safety Expert	15	5	Engineering Graduate (Electrical / Electronics) with Diploma/ Specialization in

SN	Key Position	Minimum Qualifying Requirement		
		Total Work Experience (years)	**Experience in Similar Works (years)**	**Minimum Education Qualification**
				Safety related field.
11.	RAMS Expert	15	5	Engineering Graduate with Diploma/ Specialization in RAMS.
12.	Train Management System Expert	15	5	B.E. (Electronics / Telecommunication/Electrical)

*Minimum 2 (two) years outside India experience in at least one Project

**Minimum 5 (five) years outside India experience in at least two Projects

2.6 Equipment

The Bidder shall demonstrate that it will have access to essential equipment/plants during the execution of Works. Capacity and number of machines shall be commensurate with the Works program submitted by the Bidder to enable him to finish the work in stipulated time. The Bidder shall provide ownership/renting/leasing/ arrangement details of proposed items of equipment using Form BDF-9 in Part-1, Section IV of Bidding Document.

SN	Name of Equipment / Software
1.	Cable Trencher
2.	Trenchless cabling equipment
3.	Auto fusion splicing machine

Annexure- I

Documents Required For Bid Submission and Evaluation of Technical Proposal

1.1 Type of Contract

Technical and Financial Proposals are being invited for a Lump-Sum Contract, for Design and Construction, based on the Employer's Requirements. The detailed design of all components as specified in Employers' Requirement Section-V will be carried out by the Contractor based on the Design Criteria and specifications as contained in Employer's Requirement and "DESIGN STANDARDS" given in Employers' Requirement. Construction will be based on the "General Conditions of Contract read with Particular Conditions of Contract**".**

1.2 Documents Required for Technical Proposal

The Technical Proposal will comprise of the following documents (as applicable) in addition to the documents required as per ITB 11:

1.2.1 General Submittal

S.No.	Form	Content
1	BDF-1	Technical Proposal submission sheet
2	BDF-2	Bidder Information
3	BDF-3	Bidder's Party Information
4	BDF-4	Draft Memorandum of Understanding (MOU) for joint venture participation
5	BDF-5	Draft JV Agreement
6	BDF-6	Performa- Letter of participation from each member of JV
7	BDF-7	Power of Attorney for authorise signatory of JV
8	BDF-8	Power of Attorney for lead partner of JV
9	BDF-9	Contractor's Equipment
10	BDF-10	Form for Bid Security (Bank Guarantee)
11	BDF-11	Letter of Consent
12	BDF-12	Financial Eligibility Criteria Details
13	BDF-13	Specific Experience – 2.3.1 (a)
14	BDF-14	Specific Experience – 2.3.1 (b)
15	BDF-15	Specific Experience – 2.3.1 (c)
16	BDF-16	Design Experience

S.No.	Form	Content
17	BDF-17	Pre-contract Integrity Pact
18	BDF-18	Verification affidavit
19	BDF-19	Certificate regarding GFR 2017

1.2.2 Technical Submittal

1) Methods Statement

The Bidder shall submit a method statement which demonstrates the Bidder's understanding of the Project and comprehension of the Works involved. In this methods statement, the Bidder shall submit *inter-alia* a **detailed plan for:**

- Design, procurement , Installation, testing & commissioning of material/equipment for Signalling and Telecommunication, TMS Work and Civil/Buildings/Structures Works
- Procurement/leasing/hiring of construction machines,
- Handing over the completed Works to the Employer in strict compliance with the Contract requirements. This shall correspond to Site organization, Contractor's equipment, construction schedule and Work Plan being submitted by the Bidder as a part of bid documents.
- For the activities to be carried out by specialized subcontractor, method statement shall be submitted by specialized subcontractor.

2) Organization and Management

The Bidder shall submit an organization chart identifying the management and reporting structure for key positions and all site teams. The Bidder shall submit a commentary that describes the roles and responsibilities of the various key positions in the organization structure, the minimum qualifications, channel of communication, organization they come from and how this organization structure will manage the execution of the works within the scheduled period.

3) Work Plan

The Bidder shall submit a Work Plan which shall indicate how the Bidder intends to organize and carry out the Works by breaking them into various activities and completing those activities by appropriate **Milestones** within the time of completion as mentioned in GCC para 8.2. The Work Plan shall be prepared in terms of weeks from the Date of Commencement of Works, taking D as the Commencement Date and other time schedules marked in D+ format.
(Refer to Explanatory Note 1 at the end of this Section)

4) Documents for Safety and Quality Plans

The Bidder shall submit the following documents, which shall demonstrate clearly the Bidder's proposals for achieving effective and efficient Safety and Quality procedures.

a) Outline Safety Plan

b) Outline Quality Plan

(Refer to Explanatory Note 2 at the end of this Section)

*****

Explanatory Note No. 1

Reference Paragraph 1.2.2 (3) Work Plan

Requirements of Work Plan

(1) The Bidder shall submit a Work Plan which shall indicate how the Bidder intends to organize and carry out the Works by breaking them into various activities and completing those activities by appropriate Milestones so that the whole of the work gets completed within the time of completion as mentioned in GCC para 8.2. The Work Plan shall be prepared in terms of weeks from the Date of Commencement of Works, taking D as the Commencement Date and other time schedules marked in D+ format. This may be in the form of an Excel spread sheet/ Primavera or similar program output.

(2) The Work Plan shall follow the instructions given in **Part 2, Section V, "Employer's Requirements Volume 6 Appendix 4, PROJECT PROGRAM REQUIREMENTS"**

(3) The Works Plan shall take into account the Bidder's proposed Design Submission Programme and should -

(a) be consistent with the overall Work Plan and in accordance with the Employer's Requirements;

(b) make adequate allowance for periods of time for review by authorities whose approval is necessary;

(c) include a schedule identifying, describing, cross-referencing and explaining the Design packages and submissions which the Bidder intends to submit;

(d) take due account of the design co-ordination interface periods during which the Contractor shall be required to undertake and complete all aspects of design co-ordination with other consultants engaged in the review of the design of the Project such design will be compatible and coordinated with others and allowing adequate time for the Employer's assessments and decisions.

(4) The Work Plan shall contain sufficient detail to assure the Employer of the feasibility of the plan and approach proposed by the Bidder.

(5) The Work Plan shall be accompanied by a narrative statement that shall describe Programme activities, assumptions and logic, and highlight the bidder's perception of the construction and completion of the Works. This narrative statement shall also indicate which elements of the Works the Bidder intends to carry out off-Site and/or outside India with details of the proposed locations of where any such work is to be carried out, the facilities available and any third party undertakings the Bidder may

have in this regard. In particular, the bidder must state the assumptions made in respect of the interfaces with the employer, other contractors and any requirements for information on matters which would affect his works.

(6) All programmes shall include design, procurement periods, major material, on site, offsite, offshore production/ prefabrication, temporary construction, interface and periods for System wide, utility and adjacent contractors, testing and commissioning and integrated testing along with any other training and trial running information.

The proposed submission of the Work Plan and Design Submission Programme shall not, in any event, be construed as a submission under Clause 8.3 (Programme) of the General Conditions of Contract.

Explanatory Note No. 2

Reference Paragraph 1.2.2(4) --Annexure-I - Documents for Safety and Quality Plans

OUTLINE SAFETY PLAN

The Bidder shall submit as part of his bid an Outline Safety Plan which shall contain sufficient information to demonstrate clearly the Bidder's proposals for achieving effective and efficient safety procedures. The Outline Safety Plan should include an outline of the safety procedures and regulations to be developed and the mechanism by which they will be implemented for ensuring safety as required as per the Employer's Requirements and Sub-Clause 4.8 and 6.7 of the GCC. The Outline Safety Plan shall be headed with a formal statement of policy in relation to safety and shall be sufficiently informative to define the Bidder's safety plans and set out in summary an adequate basis for the development of the Site Safety Plan to be submitted in accordance with Sub-Clause 4.8 and 6.7 of the GCC including a testing and commissioning strategy/plan for the whole of the Works.

OUTLINE QUALITY PLAN

The Bidder shall submit as part of his bid an Outline Quality Plan which shall contain sufficient information to demonstrate clearly the Bidder's proposals for achieving effective and efficient Quality Assurance and Control System. The Plan should include an outline of the procedures and regulations to be developed and the mechanism by which they will be implemented for ensuring Quality as required in terms of the Employer's Requirements. It shall also include an outline of procedures, verification and validation for all tests and materials for all the Works being done by him under this Contract.

Section IV. Bidding Forms

Table of Forms

S.No.	Form	Content
1	BDF-1	Technical Proposal submission sheet
2	BDF-2	Bidder Information
3	BDF-3	Bidder's Party Information
4	BDF-4	Draft Memorandum of Understanding (MOU[1]) for joint venture participation
5	BDF-5	Draft JV Agreement
6	BDF-6	Performa- Letter of participation from each member of JV
7	BDF-7	Power of Attorney for authorise signatory of JV
8	BDF-8	Power of Attorney for lead partner of JV
9	BDF-9	Contractor's Equipment
10	BDF-10	Form for Bid Security (Bank Guarantee)
11	BDF-11	Letter of Consent
12	BDF-12	Financial Eligibility Criteria Details
13	BDF-13	Specific Experience – 2.3.1 (a)
14	BDF-14	Specific Experience – 2.3.1 (b)
15	BDF-15	Specific Experience – 2.3.1 (c)
16	BDF-16	Design Experience
17	BDF-17	Pre-contract Integrity Pact
18	BDF-18	Verification affidavit
19	BDF-19	Certificate regarding GFR 2017
20	BDF-20	Price proposal submission sheet

[1]**In case of existing Joint Venture, the certified copy of JV Agreement be furnished.**

BDF-1

TECHNICAL PROPOSAL SUBMISSION SHEET

Date: .....

Invitation for Bid No.: **HQ/S&T/EC/D-B/ HQ/S&T/EC/D-B/DDU-BPUN**

To:.....

We, the undersigned, declare that:

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

(b) We shall be jointly and severely liable to the Employer (DFCCIL) for execution of the project in accordance with General and Special Conditions of Contract. The JV members shall also be liable jointly and severally for the loss, damages caused to the DFCCIL during the course of execution of the contract or due to non-execution of the contract or part thereof in accordance with ITB 4.1 (viii).

(c) We confirm that our offer is fully compliant with Bid document and the Technical Proposals submitted by us, are in Clause by Clause Compliance with Employer's Requirement and other specifications, including Addenda thereon. We offer to execute the Works in conformity with the Bidding Document;

(d) We hereby confirm that we have carefully studied the Access Dates, Key Dates, Interfacing requirement with other designated agencies and contractors and technical and other details, specified in the tender documents, and confirm our compliance to the Key Dates specified in the Bidding Document.

(e) Our bid shall be valid for a period of 180 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;

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

(g) If our bid is accepted, we commit to deploy key equipment and key personnel consistent with the requirements stipulated in Section-III : Evaluation and Qualification Criteria and Section-V of Employer's Requirement;

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

(i) 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;

(j) We, including any sub-contractor for any part of the contract, have eligible nationality of a country, in accordance with ITB 4.1(vii): *[insert the nationality of*

the Bidder, including that of all partners in case of a Joint Venture, and the nationality of each already identified subcontractor of related services, if applicable];

(k) We, including any sub-contractor for any part of the contract have not been declared ineligible by the Employer in accordance with ITB 4.2.

(l) We, including any sub-contractor have not been blacklisted / banned in accordance with ITB 4.4(a).

(m) We, including any sub- contractor is neither Bankrupt/Insolvent nor is in the process of winding up nor there is a case pending before any court on the deadline of submission of the Bid in Accordance with ITB 4.4(b).

(n) We, in accordance with ITB 35(a).5, plan to subcontract the following key activities and/or parts of the works.

[Insert any of the key activities identified in Section III-2.3.1(b) & 2.4 which the Bidder intends to subcontract]

(o) 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

(p) We have 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 summery 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.

(q) We understand that you are not bound to accept the lowest 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

.....

.....

BDF-2

Bidder Information Form

Date: *[insert day, month, year*]

Invitation for Bid No.: **HQ/S&T/EC/D-B/ HQ/S&T/EC/D-B/DDU-BPUN**

Page*[insert page number]*of *[insert total number]*pages

Bidder's legal name *[insert full legal name]*
In case of Joint Venture (JV), legal name of each partner: *[insert full legal name of each partner in JV]*
Bidder's Actual or Intended country of constitution: *[indicate country of Constitution]*
Bidder's actual or Intended year of constitution: *[indicate year of Constitution]*
Bidder's legal address in country of constitution: *[insert street/ number/ town or city/ country]*
Bidder's authorized representative information Name: *[insert full legal name]* Address: *[insert street/ number/ town or city/ country]* Telephone/Fax numbers: *[insert telephone/fax numbers, including country and city codes]* E-mail address: *[indicate e-mail address]*
Attached are copies of original documents of ☐ Articles of Incorporation or Documents of Constitution, and documents of registration of the legal entity named above ☐ In case of JV, JV agreement, in accordance with ITB 4.1b.

Note:- In case of JV fill only details of JV and not of individual JV members.

*****

BDF-3

Bidder's Party Information Form

[The following form shall be filled in for the Bidder's parties including partner(s) of a joint venture, subcontractors and Design Consultant]

Date: *[insert day, month, year]*

Invitation for Bid No.: **HQ/S&T/EC/D-B/ DDU-BPUN**

Page *[insert page number]* of *[insert total number]* pages

JV Bidder legal name: *[insert full legal name]*
Bidder's Party legal name: *[insert full legal name of Bidder's Party]*
Bidder's Party country of registration: *[indicate country of registration]*
Bidder Party's year of constitution: *[indicate year of constitution]*
Bidder Party's legal address in country of constitution: *[insert street/ number/ town or city/ country]*
Bidder Party's authorized representative information Name: *[insert full legal name]* Address: *[insert street/ number/ town or city/ country]* Telephone/Fax numbers: *[insert telephone/fax numbers, including country and city codes]* E-mail address: *[indicate e-mail address]*

Note: Separate BDF form is required for all individual participants (members) in the JV as well as specialized sub-contractor and Design Consultant.

*****

BDF - 4

DRAFT MEMORANDUM OF UNDERSTANDING (MOU)* For
JOINT VENTURE PARTICIPATION
BETWEEN

M/s ……..…….. having its registered office at …..……..…… (here in after referred to as ……) acting as the Lead Partner of the first part,
and
M/s …….……having its registered office at ……..……..…. (here in after referred to as `…….') in the capacity of a Joint Partner of the other part.
and
M/s …….having its registered office at ……. (here in after referred to as `…….') in the capacity of a Joint Partner of the other part.

The expressions of …….. and …….. shall wherever the context admits, mean and include their respective legal representatives, successors-in-interest and assigns and shall collectively be referred to as "the Parties" and individually as " the Party"

WHEREAS:
Dedicated Freight Corridor Corporation of India Limited(DFCCIL) [hereinafter referred to as "Client"] has invited bids for … "[Insert name of work]……..."

NOW, THEREFORE, THE PARTIES AGREE AS FOLLOWS:
1. The following documents shall be deemed to form and be read and construed as an integral part of this MOU.
   i) Notice for Bid, and
   ii) Bidding document
   iii) Any Addendum/Corrigendum issued by Dedicated Freight Corridor Corporation of India Limited
   iv) The bid submitted on our behalf jointly by the Lead Partner.

2. The `Parties' have studied the documents and have agreed to participate in submitting a `bid' jointly.

3. M/s ……shall be the lead member of the JV for all intents and purpose and shall represent the Joint Venture in its dealing with the Client. For the purpose of submission of bid proposals, the parties agree to nominate …….. as the leader duly authorized to sign and submit all documents and subsequent clarifications, if any, to the Client. However M/s …… shall not submit any such proposals, clarifications or commitments before securing the written clearance of the other partner which shall be expeditiously given by M/s……..…….to M/s…….

4. The `Parties' have resolved that the distribution of physical works/responsibilities and their proportionate financial share in the Joint Venture is as under:

(a) Lead Partner;

……....

(b) Joint Venture Partner

(i) …….…….

(ii) …….

(iii) …….……

[Similar details to be given for each partner]

5. JOINT AND SEVERAL RESPONSIBILITY

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

6. ASSIGNMENT AND THIRD PARTIES

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

7. EXECUTIVE AUTHORITY

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

8. BID SECURITIES

Till the award of the work, JV firm/Lead Partner of JV firm shall furnish Bid Security to the Client on behalf of the joint venture which shall be legally binding on all the members of the Joint Venture.

9. BID SUBMISSION

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

10. INDEMNITY

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

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

12. DOCUMENTS & CONFIDENTIALITY

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

13. ARBITRATION

Any dispute, controversy or claim arising out of or relating to this agreement shall be settled in the first instance amicably between the parties. If an amicable settlement cannot be reached as above, it will be settled by arbitration in accordance with the Indian Arbitration and Conciliation Act 2015 or any amendments thereof. The venue of the arbitration shall be Delhi.

14. VALIDITY

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

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

15. This MOU is drawn in …..... number of copies with equal legal strength and status. One copy is held by M/s ……..…… and the other by M/s…….& M/s …… and a copy submitted with the proposal.

16. This MOU shall be construed under the laws of India.

17. NOTICES

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

Lead Partner	Other Partner(s)
…….	……
(Name & Address)	(Name & Address)

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

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

Witness

1……..(Name & Address)

2…….. (Name & Address)

***Notes:** (1) In case of existing joint venture, the certified copy of JV Agreement may be furnished.

*****

BDF- 5

DRAFT FORMAT OF JOINT VENTURE AGREEMENT

To be executed on non-judicial stamp paper of appropriate value in accordance with relevant Stamp Act and to be registered with appropriate authority under Registration Act.

The JV agreement shall be structured generally as per contents list given below:

A. CONDITIONS AND TERMS OF JV AGREEMENT

1. Definitions and Interpretation
2. Joint Venture – Include Equity of members, transferability of shareholding of equity of a partner leaving during the subsistence of the contract.
3. Proposal Submission
4. Performance – To indicate scope of responsibility of each member
5. Language and Law
6. Exclusively
7. Executive Authority
8. Documents
9. Personnel
10. Assignment and Third Parties
11. Severability
12. Member in Default
13. Duration of the Agreement
14 Liability and sharing of risks
15. Insurance
16. Sharing of Promotion and Project Costs, Profits, Losses and Remuneration
17. Financial Administration and Accounting
18. Guarantees and Bonds
19. Arbitration
20. Notices
21. Sole Agreement and Variation

B. SCHEDULES

1. Project and Agreement Particulars
2. Financial Administration Services
3. Allocation of the obligations
4. Financial Policy and Remuneration

*****

BDF-6

PRO-FORMA LETTER OF PARTICIPATION FROM EACH PARTNER OF JOINT VENTURE (JV)

(To be executed on non-judicial stamp paper of appropriate value in accordance with relevant Stamp Act and to be registered with appropriate authority under Registration Act.)

No…. Dated

From:
……..
……..

To,

The Managing Director,
Dedicated Freight Corridor Corporation of India Limited
5th Floor, Supreme Court Metro Stn. Building Complex.,
New Delhi 110001.

Gentlemen,

Re: …"*[Insert name of work*]……..".

Ref: Your notice for Invitation for Bid (IFB) No. **HQ/S&T/EC/D-B/ DDU-BPUN** dated ……..

1. We wish to confirm that our company/firm has formed a Joint Venture with (i)……. & ii)…….. for the purposes associated with IFB referred to above.

*(Members who are not the lead partner of the JV should add the following paragraph)**.

2. 'The JV is led by ……..….. whom we hereby authorise to act on our behalf for the purposes of submission of Bid for ……..……. and authorise to incur liabilities and receive instructions for and on behalf of any and all the partners or constituents of the Joint Venture.'

OR

*(Member(s) being the lead member of the group should add the following paragraph)**

2. 'In this group we act as leader and, for the purposes of applying for Bid, represent the Joint Venture:

3. In the event of our JV being awarded the contract, we agree to be jointly with i) & ii) ……..…… (names of other members of our JV) and severally liable to the Dedicated

Freight Corridor Corporation of India Limited, its successors and assigns for all obligations, duties and responsibilities arising from or imposed by the contract subsequently entered into between Dedicated Freight Corridor Corporation of India Limited and our JV.

4. *I/We, further agree that entire execution of the contract shall be carried out exclusively through the lead partner.

Yours faithfully,

(Signature)

(Name of Signatory)…….

(Capacity of Signatory)……

Company Seal * Delete as applicable

Note: In case of existing joint venture, the certified copy of JV Agreement may be furnished.

BDF- 7

FORMAT FOR POWER OF ATTORNEY FOR AUTHORISED SIGNATORY OF JOINT VENTURE (JV) PARTNERS

POWER OF ATTORNEY*

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

Know all men by these presents, we do hereby constitute, appoint and authorize Mr/Ms. …. who is presently employed with us and holding the position of ……as our attorney, to do in our name and on our behalf, all such acts, deeds and things necessary in connection with or incidental to our bid for the work of ……. including signing and submission of all documents and providing information/responses to Dedicated Freight Corridor Corporation of India Limited, representing us in all matters, dealing with Dedicated Freight Corridor Corporation of India Limited in all matters in connection with our bid for the said project.

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

Dated this the …… day of ……. 202__

(Signature of authorized Signatory)

Signature of Lead Partner	**Signature of JV Partner(s)**
……	**…….**

(Signature and Name in Block letters of Signatory)

Seal of Company

Witness

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

**Notes:*

i) To be executed by all the partners jointly, in case of a Joint Venture.

*****

BDF-8

FORMAT FOR POWER OF ATTORNEY TO LEAD PARTNER OF JOINT VENTURE (JV)

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

POWER OF ATTORNEY*

Whereas Dedicated Freight Corridor Corporation of India Limited has invited Bids for the work of "Balance Works of Design, Supply, Construction, Testing and Commissioning of Signalling, Telecommunication and associated works of Double Track Railway Lines under construction on a Design Build Lump Sum basis for Deen Dayal Upadhyay - New Bhaupur Section of Eastern Dedicated Freight Corridor"

Whereas, the members of the Joint Venture comprising of M/s. ……..…..., M/s. ……..…, M/s. ……, and M/s. ……..…. are interested in submission of bid for the work of ……..……..…. *[Insert name of work*] in accordance with the terms and conditions contained in the bidding documents.

Whereas, it is necessary for the members of the Joint Venture to designate one of them as the Lead Partner, with all necessary power and authority to do, for and on behalf of the Joint Venture, all acts, deeds and things as may be necessary in connection with the Joint Venture's bid for the project, as may be necessary in connection the Joint Venture's bid for the project.

NOW THIS POWER OF ATTORNEY WITNESSETH THAT:

We, M/s. ……, M/s. ……& M/s. ……. hereby designate M/s. ……, being one of the partners of the Joint Venture, as the lead partner of the Joint Venture, to do on behalf of the Joint Venture, all or any of the acts, deeds or things necessary or incidental to the Joint Venture's bid for the contract, including submission of bid, participating in conferences, responding to queries, submission of information/ documents and generally to represent the Joint Venture in all its dealings with the Railway or any other Government Agency or any person, in connection with the Bid/contract for the said work until culmination of the process of bidding till the contract agreement if successful, is entered into with the Dedicated Freight Corridor Corporation of India Limited and thereafter till the expiry of the contract agreement.

**To be executed by all the members of the JV except the lead member.*

The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executant(s) and when it is so required the same should be under common seal affixed in accordance with the required procedure.

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

Dated this the …… Day of …….. 202__

…….
(Signature)

……
(Name in Block letters of Executants)

Seal of Company

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

BDF-9

Contractor's Equipment

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

Item of equipment		
Equipment information	Name of manufacturer	Model and power rating
	Capacity	Country of Origin and Year of manufacture
Current status	Current location	
	Details of current commitments	
Source	Indicate source of the equipment ☐ Owned ☐ Rented ☐ Leased ☐ Specially manufactured	

Omit the following information for equipment owned by the Bidder.

Owner	Name of owner	
	Address of owner	
	Telephone	Contact name and title
	Fax	Telex
Agreements	Details of rental / lease / manufacture agreements specific to the project	

BDF-10

(Clause ITB-20; Section-I & II)

Form of Bid Security (Bank Guarantee)

BANK GUARANTEE

.....Bank's Name, and Address of Issuing Branch or Office.....

Beneficiary: ..... ***Name and Address of Employer*** **.....**

Date:.....

Bid Security No.:.....

We have been informed that . . . . ***name of the Bidder***. . . . . (herein after called "the Bidder") has submitted to you its bid dated . . . . . (herein after called "the bid") for the execution of . . . . . ***name of work***. ……... . under Invitation for Bid No. . . . . (“***the IFB***”).

Furthermore, we understand that, according to your conditions, bid must be supported by a bid guarantee.

At the request of the Bidder, we . . . . . ***name of Bank***. . . . . hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of . . . . . .amount in figures . . . . . (. . . . . .***amount in words*** . . . . .) upon receipt by us of your first demand in writing accompanied by a written statement stating that the Bidder is in breach of its obligation(s) under the bid conditions, because the Bidder:

(a) has withdrawn its bid during the period of bid validity specified by the Bidder in the Form of bid;

or

(b) having been notified of the acceptance of its bid by the Employer during the period of bid validity, (i) fails or refuses to execute the Contract Agreement, or (ii) fails or refuses to furnish the Performance Security, in accordance with the ITB.

This guarantee will expire: (a) if the Bidder is the successful Bidder, upon our receipt of copies of the Contract Agreement signed by the Bidder and performance security issued to you upon the instruction of the Bidder; and (b) if the Bidder is not the successful Bidder, upon the earlier of (i) our receipt of a copy your notification to the Bidder of the name of the successful Bidder; or (ii) **Ninety days (90) after the expiration of the Bidder's bid.**

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

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

. . . . . ***.Bank's seal and authorized signature(s)*** . . . . . .

Note: All italicized text is for use in preparing this form and shall be deleted from the final document

BDF-11

Letter of Consent

(To be filled up by each Sub-contractor)

Sub-contractor's Name: [*insert full name*]
Bidder's Name: [*insert full name*]
Date: [*insert day, month, year*]
IFB No. and title: [*insert IFB number and title]*

Dear Sir,

The invitation for Bid for [*insert name of work*] has been called for by DFCCIL.

In this regard, this is an undertaking that [*insert name of Sub-contracting firm*] having its office at *[insert address of the Sub-contracting firm]* is willing to participate as sub-contractor for *[insert brief work details for which sub-contractor will provide services]* with [*insert name of bidder*] for this project: **Balance Works of Design, Supply, Construction, Testing and Commissioning of Signalling, Telecommunication and associated works of Double Track Railway Lines under construction on a Design Build Lump Sum basis for Deen Dayal Upadhyay - New Bhaupur Section of Eastern Dedicated Freight Corridor**.

[Insert name, signature and seal of authorized representative of the Sub-contractor]

BDF-12

Financial Eligibility Criteria Details 2.2.1

[The following table shall be filled in for the Bidder and for each partner of a Joint Venture]

Bidder's/Joint Venture Partner's Legal Name: *[insert full name]*
Date: *[insert day, month, year]*
Bidder's Party Legal Name: *[insert full name]*
IFB No. and title: *[insert IFB number and title]*
Page *[insert page number]* of *[insert total number]* pages

Contractual Payments Received		
Year (Financial year to be indicated by Bidder)	**Amount and Currency**	**Equivalent INR**
Current Year (2020-21)	*[insert amount and indicate currency]*	*[insert amount in INR equiv.]*
Year 1 (2019-20)		
Year 2 (2018-19)		
Year 3 (2017-18)		
Total Contractual Payment		

Note: In support of above please provide documents as detailed in Section-III, 2. Qualification, General Notes.

BDF-13

Specific Experience - 2.3.1(a)

Bidder's Legal Name: *[insert full name]*
Date: *[insert day, month, year]*
Bidder's Party Legal Name: *[insert full name]*
IFB No. and title: *[insert IFB number and title]*
Page *[insert page number]* of *[insert total number]* pages

The Bidder or member of JV must complete the information in this form as per Section III, 2. Qualification, Sub-clause 2.3.1(a).

Contract No. *[insert number]* of *[insert number of similar contracts required]*	Information	
Contract Identification	*[insert contract name and number, if applicable]*	
Award date	*[insert day, month, year, e.g., 3 June, 2012]*	
Completion date	*[insert day, month, year, e.g.-, 3 Oct, 2014]*	
Role in Contract	As Contractor/specialized sub-contractor	
Total Contract Amount	*[insert total contract amount in the currency as given in the contract]*	*[insert Total contract amount in equivalent INR]*
If member in a JV/Specialized sub contractor, specify participation in total contract amount as per section III	*Insert amount in the currency as given in the contract*	*[insert amount in INR equivalent]*
Employer's Name:	*[insert full name]*	
Address: Telephone/fax number E-mail:	*[indicate street / number / town or city / country]* *[insert telephone/fax numbers, including country and city area codes]* *[insert e-mail address, if available]*	

Similar Contract No.	***[insert number] of [insert number of similar contracts required]***
Description of the similarity for Sub-Factor 2.3.1(a)(i) of Section III:	*[insert information]*
1. Amount	*[insert amount in the currency as given in the contract and equivalent INR in words and in Figures]*
2. Physical size	*[insert physical size of activities]*
3. Complexity	*[insert description of complexity]*
4. Methods/Technology	*[insert specific aspects of the methods/technology involved in the contract]*
5. Other Characteristics	*[insert other characteristics as described in Section V, Employer's Requirements]*
OR	

Description of the similarity for Sub-Factor 2.3.1(a)(ii) of Section III:	*[insert information]*
For Signalling Work	
1. Amount	*[insert amount in the currency as given in the contract and equivalent INR in words and in Figures]*
2. Physical size	*[insert physical size of activities]*
3. Complexity	*[insert description of complexity]*
4. Methods/Technology	*[insert specific aspects of the methods/technology involved in the contract]*
5. Other Characteristics	*[insert other characteristics as described in Section V, Employer's Requirements]*
For Telecommunication Work	
1. Amount	*[insert amount in the currency as given in the contract and equivalent INR in words and in Figures]*
2. Physical size	*[insert physical size of activities]*
3. Complexity	*[insert description of complexity]*
4. Methods/Technology	*[insert specific aspects of the methods/technology involved in the contract]*
5. Other Characteristics	*[insert other characteristics as described in Section V, Employer's Requirements]*
For Civil/Building/Structure Work	
1. Amount	*[insert amount in the currency as given in the contract and equivalent INR in words and in Figures]*
2. Physical size	*[insert physical size of activities]*
3. Complexity	*[insert description of complexity]*
4. Methods/Technology	*[insert specific aspects of the methods/technology involved in the contract]*
5. Other Characteristics	*[insert other characteristics as described in Section V, Employer's Requirements]*

Note: In support of above please provide documents as detailed in Section-III, 2. Qualification, General Notes.

BDF-14

Specific Experience – 2.3.1 (b)

Bidder's Legal Name: *[insert full name]*
Date: *[insert day, month, year]*
Bidder's Party Legal Name: *[insert full name]*
IFB No. and title: *[insert IFB number and title]*
Page *[insert page number]* of *[insert total number]* pages

The Bidder or member of JV or specialized sub-contractor must complete the information in this form as per Section III, 2. Qualification, Sub-clause 2.3.1(b).

Contract No. *[insert number]* of *[insert number of similar contracts required]*	Information	
Contract Identification	*[insert contract name and number, if applicable]*	
Award date	*[insert day, month, year, e.g., 3 June, 2012]*	
Completion date	*[insert day, month, year, e.g.-, 3 Oct, 2014]*	
Role in Contract	As Contractor/specialized sub-contractor	
Total Contract Amount	*[insert total contract amount in the currency as given in the contract]*	*[insert Total contract amount in equivalent INR]*
If member in a JV/Specialized sub contractor, specify participation in total contract amount as per section III	*Insert amount in the currency as given in the contract*	*[insert amount in INR equivalent]*
Employer's Name:	*[insert full name]*	
Address: Telephone/fax number E-mail:	*[indicate street / number / town or city / country]* *[insert telephone/fax numbers, including country and city area codes]* *[insert e-mail address, if available]*	

Similar Contract No.	***[insert number] of [insert number of similar contracts required]***
Description of the similarity for Sub-Factor 2.3.1(b) of Section III:	*[insert information]*
Train Management System (TMS)/ Centralized Train Control system (CTCS) on Railway/ Metro Rail/ Suburban Rail transit system	
1. Amount	*[insert amount in the currency as given in the contract and equivalent INR in words and in Figures]*
2. Physical size	*[insert physical size of activities]*
3. Complexity	*[insert description of complexity]*
4. Methods/Technology	*[insert specific aspects of the methods/technology involved in the contract]*
5. Other Characteristics	*[insert other characteristics as described in Section V, Employer's Requirements]*

Note: In support of above please provide documents as detailed in Section-III, 2. Qualification, General Notes.

BDF-15

Specific Experience - 2.3.1(c)

Bidder's Legal Name: *[insert full name]*
Date: *[insert day, month, year]*
Bidder's Party Legal Name: *[insert full name]*
IFB No. and title: *[insert IFB number and title]*
Page *[insert page number]* of *[insert total number]* pages

The Bidder or member of JV must complete the information in this form as per Section III, 2. Qualification, Sub-clause 2.3.1(c).

Contract No. *[insert number]* of *[insert number of similar contracts required]*	Information	
Contract Identification	*[insert contract name and number, if applicable]*	
Award date	*[insert day, month, year, e.g., 3 June, 2012]*	
Completion date	*[insert day, month, year, e.g.-, 3 Oct, 2014]*	
Role in Contract	As Contractor/specialized sub-contractor	
Total Contract Amount	*[insert total contract amount in the currency as given in the contract]*	*[insert Total contract amount in equivalent INR]*
If member in a JV/Specialized sub contractor, specify participation in total contract amount as per section III	*Insert amount in the currency as given in the contract*	*[insert amount in INR equivalent]*
Employer's Name:	*[insert full name]*	
Address: Telephone/fax number E-mail:	*[indicate street / number / town or city / country]* *[insert telephone/fax numbers, including country and city area codes]* *[insert e-mail address, if available]*	

Similar Contract No.	***[insert number] of [insert number of similar contracts required]***
Description of the similarity for Sub-Factor 2.3.1(c)(a) of Section III:	*[insert information]*
For Signalling Work	
1. Amount	*[insert amount in the currency as given in the contract and equivalent INR in words and in Figures]*
2. Physical size	*[insert physical size of activities]*
3. Complexity	*[insert description of complexity]*
4. Methods/Technology	*[insert specific aspects of the methods/technology involved in the contract]*

5. Other Characteristics	*[insert other characteristics as described in Section V, Employer's Requirements]*
OR	
Description of the similarity for Sub-Factor 2.3.1(c)(b) of Section III:	*[insert information]*
For Telecommunication Work	
1. Amount	*[insert amount in the currency as given in the contract and equivalent INR in words and in Figures]*
2. Physical size	*[insert physical size of activities]*
3. Complexity	*[insert description of complexity]*
4. Methods/Technology	*[insert specific aspects of the methods/technology involved in the contract]*
5. Other Characteristics	*[insert other characteristics as described in Section V, Employer's Requirements]*
OR	
Description of the similarity for Sub-Factor 2.3.1(c)(c) of Section III:	*[insert information]*
For Civil/Building/Structure Work	
1. Amount	*[insert amount in the currency as given in the contract and equivalent INR in words and in Figures]*
2. Physical size	*[insert physical size of activities]*
3. Complexity	*[insert description of complexity]*
4. Methods/Technology	*[insert specific aspects of the methods/technology involved in the contract]*
5. Other Characteristics	*[insert other characteristics as described in Section V, Employer's Requirements]*

Note: In support of above please provide documents as detailed in Section-III, 2. Qualification, General Notes.

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Design Experience-2.4

Bidder's Legal Name: *[insert full name]*
Date: *[insert day, month, year]*
Bidder's Party Legal Name: *[insert full name]*
Nominated Subcontractor's Legal Name (if applicable): *[insert full name]*
IFB No. and title: *[insert IFB number and title]*
Page *[insert page number]* of *[insert total number]* pages

Bidders or Specialized Subcontractor for key activities must complete the information in this form as per Section III, 2. Qualification, Sub-Factor 2.4.

1. Key Design Activity No. _____: *[insert brief description of the Activity, emphasizing its specificity]*

	Information	
Contract Identification	*[insert contract name and number, if applicable]*	
Award date	*[insert day, month, year]*	
Completion date	*[insert day, month, year]*	
Role in Contract *[check the appropriate box]*	Design Consultant	In house Designer
Total Contract Amount	*[insert total contract amount in the currency as given in the contract]*	*[insert Total contract amount in equivalent INR]*
Employer's Name:	*[insert full name]*	
Address: Telephone/fax number E-mail:	*[indicate street / number / town or city / country]* *[insert telephone/fax numbers, including country and city area codes]* *[insert e-mail address, if available]*	
Description of the key activity in accordance with Sub-Factor 2.4 of Section III:	*[insert response to inquiry indicated in left column]*	

Note: In support of above please provide documents as detailed in Section-III, 2. Qualification, General Notes.

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PRE CONTRACT INTEGRITY PACT
General

This pre-bid pre-contract Agreement (hereinafter called the Integrity Pact) is made on----------day of the month of---------- 20xx, between, on one hand, the DFCCIL acting through Shri ----- ---------- Designation of the officer, (hereinafter called the CLIENT, which expression shall mean and include, unless the context otherwise requires, his successors in office and assigns) of the First Part and M/s---------- represented by Shri ----------Chief Executive Officer (hereinafter called the "BIDDER/SELLER" which expression shall mean and include, unless the context otherwise requires, his successors and permitted assigns) of the Second part.

WHEREAS the CLIENT proposes to procure (Name of the Stores/Equipment/Item, Name of the Consultancy Service, Name of Works Contract, Name of Services) and the [A] is willing to Offer/has offered for stores or works.

WHEREAS the [A] is a private company/ public company/ Government undertaking/ partnership/ registered export agency, constituted in accordance with the relevant law in the matter and the CLIENT is a PSU performing its functions or behalf of the President of India.

NOW, THEREFOR,

To avoid all forms of corruption by following a system that is fair, transparent and free from any influence/prejudiced dealings prior to, during and subsequent to the currency of the contract to be entered into with a view to:-

Enabling the CLIENT to obtain the desired said (Name of the Stores/Equipment/Item, Name of the Consultancy Service, Name of Works Contract, Name of Services) at a competitive price in conformity with the defined specifications by avoiding the high cost and the distortionary impact of corruption on public procurement, and

Enabling BIDDERs to abstain from bribing or indulging in any corrupt practice in order to secure [B] by providing assurance to them that their competitors will also abstain from bribing and other corrupt practices and the CLIENT will commit to prevent corruption, in any form, by its Officials by following transparent procedures.

The parties hereto hereby agree to enter into this Integrity Pact and agree as follows:

Commitments of the CLIENT

1. The CLIENT undertakes that no official of the CLIENT, connected directly or indirectly with the [B], will demand, take a promise for or accept, directly or through intermediaries, any bribe, consideration, gift, reward, favour or any material or immaterial benefit or any other advantage from the [A] either for themselves or for any person, organization or third party related to the [B], in exchange for an advantage in the bidding process, bid evaluation, contracting or implementation process related to the [B].

    1.1 The CLIENT will, during the pre-contract stage, treat all BIDDERs alike, and will provide to all BIDDERs the same information and will not provide any such information

to any particular BIDDER which could afford an advantage to that particular [A] in comparison to other BIDDERs.

1.2 All the officials of the CLIENT will report to the appropriate Government office any attempted or completed breaches of the above commitments as well as any substantial suspicion of such a breach.

2. In case any such preceding misconduct on the part of such official(s) in reported by the [A] to the CLIENT with full, and verifiable facts and the same is prima facie found to be correct by the CLIENT, necessary disciplinary proceedings, or any other action as deemed fit, including criminal proceedings may be initiated by the CLIENT and such a person shall be debarred from further dealings related to the [B] process. In such a case while an enquiry is being conducted by the CLIENT the proceedings under the [B] would not be stalled.

Commitments of BIDDERS

3. The [A] commits itself to take all measures necessary to prevent corrupt practices, unfair means and illegal activities during any stage of its bid or during any pre-contract or post-contract stage) in order to secure the [B] contract or in furtherance to secure it and in particular committee itself to the following:-

3.1 The [A] will not offer, directly or through intermediaries, any bribe, gift, consideration, reward, favour, any material or immaterial benefit or other advantage, commission fees, brokerage or inducement to any official of the CLIENT, connected directly or indirectly with the bidding process, or to any person, organization or third party related to the [B] in exchange for any advantage in the bidding, evaluation, contracting and implementation of the [B].

3.2 The [A] further undertakes that it has not given, offered or promised to give, directly or indirectly any bribe, gift, consideration, reward, favour, any Material or immaterial benefit or other advantage, commission, fees, brokerage or inducement to any official of the CLIENT or otherwise in procuring the Contract or forbearing to do or having done any act in relation to the obtaining or execution of the [B] or any other [B] with the Government for showing or forbearing to show favour or disfavor to any person in relation to the [B] or any other [B] with the Government.

3.3 * [A] shall disclose the name and address of agents and representatives and Indian [A] shall disclose their foreign principals or associates.

3.4 * [A] shall disclose the payments to be made by them to agents/brokers or any other intermediary, in connection with this bid/contract.

3.5 The [A] further confirms and declares to the CLIENT that the [A] is the original manufacturer/integrator/authorized government sponsored export entity of the defense stores and has not engaged any individual or firm or company whether Indian or foreign to intercede, facilitate or in any way to recommend to the CLIENT or any of its functionaries, whether officially or unofficially to the award of the [B] to the [A] nor has any amount been paid, promised or intended to be paid to any such individual, firm or company in respect of any such intercession, facilitation or recommendation.

3.6 The [A] either while presenting the bid or during pre-contract negotiations or before signing the [B] shall disclose any payments he has made, is committed to or intends to make to officials of the CLIENT or their family members, agents, brokers or any other intermediaries in connection with the [B] and the details of services agreed upon for such payments.

3.7 The [A] will not collude with other parties interested in the [B] to impair the transparency, fairness and progress of the bidding process, bid evaluation, contracting and implementation of the [B].

3.8 The [A] will not accept any advantage in exchange for any corrupt practice, unfair means and illegal activities.

3.9 The [A] shall not use improperly, for purposes of competition or personal gain, or pass on to others, any information provided by the CLIENT as part of the business relationship, regarding plans, technical proposals and business details, including information contained in any electronic data carrier. The [A] also undertakes to exercise due and adequate care lest any such information is divulged.

3.10 The [A] commits to refrain from giving any complaint directly or through any other manner without Supporting it with full and verifiable facts.

3.11 The [A] shall not instigate or cause to instigate any third person to commit any of the actions mentioned above.

3.12 If the, [A] or any employee of the [A] or any person acting on behalf of the [A], either directly or Indirectly, is a relative of any of the officers of the CLIENT, or alternatively, if any relative of an officer of the CLIENT has financial. Interest/stake in the Bidder's firm, the same shall be disclosed by the [A] at the time of filling of tender. The term 'relative' for this purpose would be as defined in section 6 of the companies act 1956.

3.13 The [A] shall not lend to or borrow any money from or enter into any monetary dealings or transactions, directly or indirectly, with any employee of the CLIENT.

4. Previous Transaction

4.1 The [A] declares that no previous transgression occurred in the last three years immediately before signing of this integrity Pact, with any other company in any country in respect of any corrupt practices envisaged hereunder or with any public sector enterprise in India or any Government department in India that could justify BIDDER's from the tender process.

4.2 The [A] agrees that if it makes incorrect statement on this subject, [A] can be disqualified from the ender process or the contact, if already awarded, can be terminated for such reason.

5. Bid Security Deposit

5.1 The Earnest money/ Bid Security/ Security Deposit/ Retention money/ Performance guarantee shall be as per the provisions of Bid document.

6. Sanctions for Violations

6.1 Any breach of the aforesaid provisions by the [A] or any one employed by it or acting on its behalf (whether with or without the knowledge of the [A] shall entitle the CLIENT to take all or any one of the following actions, wherever required :-

(i) To immediately call off the pre-contract negotiations without assigning any reason or giving any compensation to the [A]. However, the proceedings with the other BIDDER(s) would continue.

(ii) The earnest money deposit (in pre-contract stage) and/or security Deposit/performance Bond (after the [B] is signed) shall stand forfeited fully and the CLIENT shall not be required to assign any reason therefore.

(iii) To immediately cancel the [B], if already signed, without giving any compensation to the [A].

(iv) To recover all sums already paid by the CLIENT, and in case of an Indian [A] with interest thereon at 2% higher that the prevailing prime lending rate of state bank of India, while in case of a [A] from the country other that India with

interest thereon at 2% higher than the LIBOR. If any outstanding payment is due to [A] from the CLIENT in connection with any other [B], such outstanding payment could also be utilized to recover the aforesaid sum and interest.

(v) To encash the advance bank guarantee and performance bond, if furnished by the [A], in order to recover the payments, already made by CLIENT, along with interest.

(vi) To cancel all or any other contracts with the [A]. The [A] shall be liable to pay compensation for any loss or damage to the Client resulting from such cancellation/rescission and the client shall be entitled to deduct the amount so payable from the money(s) due to the [A].

(vii) To debar the [A] from participating in future bidding processes of the Government of India for a minimum period of five years, which may be further extended at the discretion of the CLIENT.

(viii) To recover all sums paid in violation of this pact by [A]) to any middleman or agent or broker with a view a view to securing [B] the contract.

(ix) In cases where irrevocable letters of credit have been received in respect of any [B] signed by the client with the [A], the shall not be opened.

(x) Forfeiture of Performance Bond in case of a decision by the client to forfeit the same without assigning any reason for imposing sanction for violation of this pact.

6.2 The client will entitled to take all or any of the actions mentioned at para 6.1(i) to (x) of this pact also on the commission by the [A] or any one employed by it or acting on its behalf (whether with or without the knowledge of the [A], of an offence as defined in chapter IX of the Indian penal code, 1860 or prevention of Corruption Act, 1988 or any other statute enacted for prevention of corruption.

6.3 The decision of the CLIENT to the effect that a breach of the provisions of this pact has been committed by the [A] shall be final and conclusive on the [A]. However, the [A] can approach the Independent Monitor(s) appointed for the purposes of this Pact.

7. Fall Clause

7.1 The [A] undertakes that it has not supplied/is not supplying similar product/systems or subsystems at a price lower than that offered in the present bid in respect of any other Ministry/Department of the Government of India or PSU and if it is found at any stage that similar product/system or sub systems way supplied by [A] to any other Ministry/Department of the Government of India or a PSU at a lower price, then that very price, with due allowance for elapsed time, will be applicable to the present case and the difference in the cost would be refunded by the [A] to the CLIENT, if the [B] has already been concluded.

8. Independent Monitors

8.1 The CLIENT has appointed Independent Monitors (hereinafter referred to as Monitors) for this pact in consultant with the central vigilance commission (Names and addresses of the Monitors to be given)

8.2 the task of the Monitors shall be to review independently and objectively, whether and to what extent the parties comply with the obligations under this pact.

8.3 The monitors shall not be subject to instructions by the representatives of the parties and perform their functions neutrally and independently.

8.4 Both the parties accept that the Monitors have the right to access all the documents relating to the project/procurement, including minutes of meetings.

8.5 As soon as the Monitor notices, or has reason to believe, a violation of this Pact, he will so inform the Authority designated by the CLIENT

8.6 The BIDDER(s) accepts that the Monitor has the right to access without restriction to all Project documentation of the CLIENT including that provided by the BIDOER. The [A] will also grant the Monitor, upon his request and demonstration of a valid Interest, unrestricted and unconditional access to his project documentation. The same is applicable to Subcontractors. The Monitor shall be und 'contractual obligation to treat the information and documents of the [A] with confidentiality.

8.7 The client will provide to the Monitor sufficient information about all meetings among the parties related to the Project provided such meetings could have an impact on the contractual relations between the parties. The parties will offer to the Monitor the option to participate in such meetings.

8.8 The monitor will submit a written report to the MD/DFCCIL within 8 to 10 weeks from the date of reference or intimation to him by the CLIENT/BIDDER and, should the occasion arise, submit proposal for correcting problematic situations.

9. Facilitation of Investigation
In case of any allegation of violation of any provisions of this Pact or payment of commission, the CLIENT or its agencies shall be entitled to examine all the documents including the Books of Accounts of the [A] and the [A] shall provide necessary information and documents in English and shall extend all possible help for the purpose of such examination.

10. Law and Place of Jurisdiction
This pact is subject to Indian law. The place of performance and jurisdiction is the seat of the CLIENT.

11. Other Legal Actions
The actions stipulated in this integrity pact are without prejudice to any other legal action that may follow in accordance with the provisions of the extant law in force relating to any civil or criminal proceedings.

12. Validity

12.1 The validity of this integrity pact shall be from date of its signing and extend upto 5 years or the complete execution of the [B] to the satisfaction of both the CLIENT and the [A] including warranty period, whichever is later. In case [A] is unsuccessful, this integrity pact shall expire after six months from the date of the signing of the [B].

12.2 Should one or several provisions of this pact turn out to be invalid; the remainder of this pact shall remain valid. In this case, the parties will strive to come to an agreement to their original intentions.

13. The parties hereby sign this integrity pact at …….. on …….

CLIENT BIDDER	CHIEF EXEUCTIVE OFFICER
Name of the officer	
Designation	
Deptt./Ministry/PSU	
Witness	Witness
1. ……	2. ……

Note:
[A]- To be replaced by BIDDER/Seller/Consultant/Consultancy firm/Service provider as the case was may be.
[B]- To be replaced by contract/supply contract/consultancy contract/works contract as the case was may be.

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FORMAT FOR AFFIDEVIT TO BE SUBMITTED BY BIDDER ALONGWITH THE BID DOCUMENT

(Clause ITB-44, Section-I, Part-1)

(To be executed in presence of Public notary on non-judicial stamp paper of the value of Rs. 100/- The stamp paper has to be in the name of the bidder)**

IFB No……..

Name of Work:……

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 documents for the work of …… ……..as per the IFB No…….. …….. of DFCCIL, do hereby solemnly affirm and state on the behalf of the bidder including its constituents as under:

1. I/we the bidder(s), am/are signing this document after carefully reading the contents.
2. I/we the bidder(s) also accept all the conditions of the bid and have signed all the pages in confirmation thereof.
3. I/we hereby declare that I/we have downloaded the bid document from the website www.dfccil.com. I/we have verified the content of the document from the website and there is no addition, no deletion or no alteration to the content of the bid document. In case of any discrepancy noticed at any stage i.e evolution of bids, execution of work of final payment of the contract, the master copy available with the DFCCIL shall be final and binding upon me/us.
4. I/we declare and certify that I/we have not made any misleading or false representation in the forms, statements and attachments in proof of the qualification requirements.
5. **I/we also understand that my/our offer will be evaluated based on the document/credentials submitted along with the offer and same shall be binding upon me/us.**
6. **I/we declare that the information and documents submitted along with the bid by me/us are correct and I/we are fully responsible for the correctness for the information and documents, submitted by us.**
7. I/we understand that if the certificates regarding eligibility criteria submitted by us are found to be forged/false or incorrect at any time during process for evaluation of bids, it shall lead to forfeiture of the bid security besides banning of business for five year on entire DFCCIL. Further, I/we (insert name of the bidder)**……. and all my/our constituents understand that my/our offer shall be summarily rejected.
8. I/we also understand that if the certificates submitted by us found to be false/forged or incorrect at any time after the award of the contract, it will lead to termination of the contract, alongwith forfeiture of Bid Security, retention money and Performance guarantee besides any other provided in the contract including banning of business for five year on entire DFCCIL.

DEPONENT
SEAL AND SIGNATURE
OF THE BIDDER

VERIFICATION

I/we above named bidder do hereby solemnly affirm and verify that the contents of my/our above affidavit are true and correct. Nothing has been concealed and no part of it is false.

DEPONENT

SEAL AND SIGNATURE
OF THE BIDDER

Place:

Dated:

**The contents in Italics are only for guidance purpose. Details as appropriate, are to be filled in suitably by bidder.

Attestation before Magistrate/Notary Pubic

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(ITB 46, Section-I)

CERTIFICATE REGARDING GFR 2017

Bidder's Name: [insert full name]
Date: [insert day, month, year]
Bidder's Party Name: [insert full name]
IFB No. and title: [insert IFB number and title]

The invitation for Bid for [insert name of work]

To:……...

I/We hereby declare that:

I/We have read the clause regarding restrictions on procurement from a bidder of a country which shares a land border with India and on sub-contracting to contractors/vendor/supplier from such countries; I/We certify that this bidder is not from such a country or, if from such a country, has been registered with the Competent Authority and will not sub-contract any work to a sub-contractor/vendor/supplier from such countries unless such sub-contractor is registered with the Competent Authority. I/We hereby certify that this bidder fulfils all requirements in this regard and is eligible to be considered. [Where applicable, evidence of valid registration by the Competent Authority shall be attached]

Signature of Authorized Representative…….

Name of Authorized Representative ……

Designation……..

Stamp/Seal ……

Date…….

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PRICE PROPOSAL SUBMISSION SHEET

Please refer Part-5 (Price Schedule) for this form

डेडीकेटेड फ्रेट कोरीडोर

BID DOCUMENT FOR BALANCE WORKS OF DESIGN, SUPPLY, CONSTRUCTION, TESTING AND COMMISSIONING OF SIGNALLING, TELECOMMUNICATION AND ASSOCIATED WORKS OF DOUBLE TRACK RAILWAY LINES UNDER CONSTRUCTION ON A DESIGN BUILD LUMP SUM BASIS FOR DEEN DAYAL UPADHYAY - NEW BHAUPUR SECTION OF EASTERN DEDICATED FREIGHTCORRIDOR

SIGNALLING AND TELECOMMUNICATION WORKS
CONTRACT PACKAGE: 203(R)

Issued on: 27.08.2020

IFB No.: HQ/S&T/EC/D-B/DDU-BPUN

Part-2, Section V(A)
General Specifications

Employer:

DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LIMITED

A GOVERNMENT OF INDIA ENTERPRISE

under

MINISTRY OF RAILWAYS

INDIA

PART 2

Employer's Requirement

PART 2 – Employer's Requirements

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GENRERAL SPECIFICATIONS

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Volume 1 – Scope of Works

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1.0 General

1.1 Dedicated Freight Corridor Corporation of India Ltd. (DFCCIL), a public sector undertaking, has been set up under the Indian Companies Act 1956 for implementation of Dedicated Freight Corridor Project. Government of India is the sole shareholder of the DFCCIL. DFCCIL has planned to construct a Dedicated Freight Corridor (DFC) covering about 3363 route kilometers on Eastern and Western Corridors. The coverage of Eastern Corridor is from Ludhiana to Dankuni and that of Western Corridor (WDFC) from Jawaharlal Nehru Port, Mumbai to Dadri near Delhi. There will be a linkage between two corridors at Dadri.

1.2 Eastern DFC Route will be approximately 1847 km long from Dankuni to Sahnewal (Ludhiana) via Dankuni–Asansol–Dhanbad–Gaya–Sonnagar–Deen Dayal Upadhyay–Allahabad- Kanpur–Tundla–Aligarh-Khurja-Hapur–Meerut–Saharanpur–Ambala–Sahnewal.

1.3 EDFC Phase-1 covers the construction of Double Line Electrified Section of approximately 343 route km length between New Bhaupur and New Khurja.

EDFC Phase-2 covers the construction of Electrified Section covering a route length of approximately 388.14Km (Double Line) between Deen Dayal Upadhyay and New Bhaupur; and approximately 29.15 Km (Single Line) between Junction Stations and IR Stations. Bulk of the length between Deen Dayal Upadhyay and New Bhaupur runs parallel and close to the existing IR network. However, detours have been planned at eight locations. This section has 6 Junction Stations and 6 Crossing Stations. These Junction Stations are connected with the stations of IR for entry/exit of the trains to IR from DFC through Single Line Electrified Sections covering route length of approximately 29.15 route km.

EDFC Phase-3 involves construction of Single Line Electrified Section of about 404 route km between Khurja-Meerut Saharanpur-Ambala-Sahnewal (near Ludhiana) and about 46 km of Double Line Electrified Section connecting Khurja and Dadri; where it links with Western Corridor of DFC.

1.4 The section between Deen Dayal Upadhyay-Sonnagar (122 RKM) is Double Line Electrified Section under construction by direct funding from Ministry of Railways.

1.5 The section between Sonnagar-Dankuni (534 RKM) will be implemented through Public Private Partnership (PPP).

1.6 The bridges and formation will be designed for 32.5T axle load while the track structure will be designed for 25T axle load operating at train speed of up to 100 kmph.

1.7 The Eastern Corridor will handle single stack containers whereas Western Corridor is planned to cater to double stack containers.

1.8 Upgradation of transportation technology, increase in productivity and reduction in unit transportation costs have been taken as guiding principles for formulating the project. Various operating systems, motive powers, signalling and work processes are required to conform to these broad perspectives.

2.0 Project Information of DDU-New Bhaupur section of EDFC (Phase-2)

2.1 EDFC Phase-2 covers the construction of Double Line Electrified Section covering a route length of approximately 388.14 km between Deen Dayal Upadhyay and New Bhaupur and Single Line Electrified Sections covering route length of approximately 29.15 km between Junction Stations and IR stations. The details are as below

2.1.1 The Double Line Section covers a route length of approximately 388.14 km between Deen Dayal Upadhyay and New Bhaupur. Bulk of the length between Deen Dayal Upadhyay and New Bhaupur runs parallel and close to the existing IR network. However, detours have been planned at eight locations. The details of this Double Line Section are as follows:

Contract Package	Existing Railway Km/(DFC Chainage)		Approx. Total Route Length	Remarks
	From	To		
CP-201	Km-669.670/ (Ch-119.550)	Km- /(Ch-278.155)	158.605 (DL) 22.430 (SL)	Parallel Length (DL)– 121.985 km Detour Length (DL) – 36.620 km Link Line Length(SL)- 22.430 Km
CP-202	Km– /(Ch.278.155)	Km– /(Ch-507.693)	229.538 (DL) 6.720(Km)	Parallel Length (DL) – 139.889 km Detour Length (DL) – 89.649 km Link Line Length(SL)- 6.720 Km

2.1.2 The Junction Stations of EDFC Phase-2 are connected through Single Line Sections with the Stations of Indian Railways for entry/exit of the trains from/to Indian Railways. The details of these Single Line Sections are as follows:

DFCC Junction Station – IR station	Approximate Route km
Deen Dayal Upadhyay(EDFC)-Deen Dayal Upadhyay(IR)	Parallel to IR Yard
New Ahraura Road–Jeonathpur(IR)	8.73 km
New Karchana–Cheoki(IR)	4.8 km
New Karchana–Iradatganj(IR)	8.9 km
New Kanpur–Rooma(IR)	4.04 km
New Bhimsen–Bhimsen(IR)	2.68 km
New Sujatpur-Sujatpur (IR)	3.025 km

2.1.3 The salient features of the Track Structure and Formation on Deen Dayal Upadhyay-New Bhaupur Section of Eastern Dedicated Freight Corridor are as follows:

SN	Description	Details & Particular
1.	Gauge	1676millimeters
2.	Main Line, Loops and Sidings	60 kg/M Rail, 1 in 12 curved thick web switches with CMS Crossings on Fan shaped PSC Sleepers layout
3.	Sleepers	PSC Mono-Block, 60 kg/M
4.	Formation Width a) Embankment (Straight Track) b) Cuttings(Straight Track) excluding side drains	 For Double line : 13500 mm minimum For Single line : 7600 mm For Double line : 13500 mm minimum For Single line : 7500 mm
5.	Radii of curves	Shall generally be not less than 700meters on main lines (2.5 degrees)
6.	Maximum gradient	1:200 compensated
7.	Slope Gradient for Ballast Section	As per RDSO GE: 0014
8.	Cross Slope on top of formation	1 in 30
9.	Formation	As per guidelines and specifications for design formation for Heavy (32.5 T) Axle Load stipulated by GE: 0014
10.	Ballast Cushion a) Main Line b) Loop Line and sidings	 350 millimeters 250 millimeters
11.	Bridges	32.5 T Axle Load DFC Loading

2.1.4 The list of Junction & Crossing Stations along with their chainages in EDFC Phase-2 are detailed as below:

(1) **Junction Stations**

Junction Stations are the interchange stations with Indian Railways. These Junction Stations with their respective chainages (indicative) for Deen Dayal Upadhyay-New Bhaupur section are as detailed below:

SN	Name of Station	Chainage of Centre Line of the Station
1.	Deen Dayal Upadhyay	Km 124.626
2.	New Ahraura Road	Km 138.675
3.	New Karchana	Km 269.155

4.	New Sujatpur	Km 333.607
5.	New Bhimsen	Km 485.910
6	New Kanpur	Km 460.536

(2) **Crossing Stations**

The list of Crossing stations with their respective chainages (Indicative) for Deen Dayal Upadhyay-New Bhaupur section are as detailed below:

SN	Name of Station	Chainage of Center Line of the Station
1.	New Dagmagpur	Km 162.500
2.	New Mirjapur	Km 192.700
3.	New Unchdih	Km 234.900
4.	New Manauri	Km 295.772
5.	New Rasulabad	Km 378.309
6.	New Malwan	Km 422.665

2.1.5 Level Crossings Gates

There are 75 level crossing gates in Deen Dayal Upadhyay-New Bhaupur Section, i.e.in EDFC Phase-2, which will be replaced by ROB/RUB in a phased manner. It is anticipated that on 15 LC Gates, the work of ROB/RUB is not likely to be completed before the commissioning of Freight Corridor in the Section. Therefore these 15LC Gates will be required to be interlocked with Gate Signals. New Gate Lodges will also be built on all the 15 LC Gates to be interlocked. The details of these Level Crossings are placed below.

LIST OF LEVEL CROSSINGS TO BE RETAINED

S.N.	LC Gate no.	Section	ROB/ RUB	TVU	Chainage (DFC)	IR Km
1.	112C	DDU-JEP	RUB	25161	127.886	675/15-17
2.	115-C	JEP-ARW	RUB/ROB	99792	135.253	682/28-00
3.	119-B	ARW-KYT	ROB	828954	144.896	692/15-17
4.	122C	CAR YARD	ROB	316830	157.865	705/23-25
5.	10A	BDL-BEO	ROB	297250	202.500	744/13-15
6.	12B	GAE Yard	RUB/ROB	121500	213.400	755/19-21
7.	20C	MNF-UND	ROB	161070	233.290	775/3-5
8.	26C	MJA Yard	ROB	526575	247.465	789/9-11
9.	27-C	BEP Yard	ROB	157707	256.095	797/27-29
10.	29-B	BEP-KCN	ROB	188063	259.685	801/13-15
11.	31C	KCN Yard	RUB	65799	265.833	807/23-25
12.	32C	Allahabad-Kanpur	ROB	348620	348.620	830/13-15
13.	60B	Allahabad-Kanpur	ROB	103622	429.235	986/07-09

14.	72B	Allahabad-Kanpur	ROB	459330	459.330	997/13-15
15.	236	Bhimsen-Govindpuri	RUB	30402	2+511	1334/04-06

NOTE: This list of Level Crossing Gates is indicative. Although the total number of LC Gates will remain 15, however their location, chainage and LC No. may change during course of work.

2.1.6 Maintenance Depots

The Integrated Maintenance Depots (IMDs) and Integrated Maintenance Sub Depots (IMSDs) as indicated below have been planned in EDFC Phase-2. These depots will have maintenance facilities for assets Electrical, Civil, Signal & Telecommunication. The locations of these Integrated Maintenance Depots (IMDs) and Integrated Maintenance Sub- Depots (IMSD) is given below:

SN	Place of IMD	Place of IMSD
1	Deen Dayal Upadhyay,	New Dagmagpur
2	New Karchana	New Unchdih
3	New Kanpur	New Manauri
4	--	New Rasulabad
5	--	New Malwan

2.1.7 DFCC has planned residential complexes for its staff. A total no. of 263 Residential Quarter/Houses, 1 Guest House and 1 Club/Institute shall be constructed in EDFC Phase-2.

2.1.8 **Operation Control Center Facilities**

Centralized Operational Control Centre (OCC) for the entire Eastern Dedicated Freight Corridor, i.e. including EDFC Phase-2, has been constructed at Allahabad under a separate Contract Package CP-104. The OCC shall house the Train Management System and Traction Power SCADA for entire EDFC. All the controllers such as Traffic Controllers, Track Controller, Traction Power Controllers, and Signal Fault Controller etc. shall monitor and manage all train operations and associated activities, including maintenance of entire EDFC from the OCC.

2.1.9 Electrical System

2.1.9.1 The entire section of EDFC Phase-2 shall be provided with 2x25 kV AC, 50 Hz, AT Feeding, Electric Traction Power System. This Electric Traction Power System shall also include Traction Sub-station (TSS), Sectioning Post (SP) and Sub-sectioning Post (SSP).The Employer has acquired land for TSSs, SPs and SSPs at locations as given below. These locations of TSSs, SPs and SSPs are tentative and may change during execution of work for EDFC Phase-2.

Employer has acquired land for TSSs, SPs and SSPs shown in Table 1, 2 and 3. These locations are tentative and may change during execution of Contract Package-204.

Table 1 List of Proposed Traction Substations (TSS)

S. No	Installation Name	IR Chainages including detour KMs	DFCC Chainage (in Km
1.	Deoria TSS	681	133.133
2.	Chandaipur TSS	Detour	194.274
3.	Gadhiaw TSS	800/21-25	258.774
4.	Bharwari TSS	861.5	317.051
5.	New Rasulabad TSS	920	379.139
6.	Aun TSS	980.3	442.117
7.	Piturur TSS	Detour	501.773

Table 2 List of Proposed Sectioning and Paralleling Posts (SP)

S. No	Installation Name	IR Chainages including detour KMs	DFCC Chainage (in Km
1.	Newari SP	712/17-19	164.91
2.	Kukhuri SP	767/21-23	225.533
3.	SubedarGanj SP	Detour	288.205
4.	Athsarai SP	889/15-19	347.739
5.	KurastiKalan SP	951/5-7	413.341
6.	Chakeri SP	Detour	472.071

Table 3 List of Proposed Sub Sectioning and Paralleling Posts (SSP) (Mid-Section)

S. No	Installation Name	IR Chainages including detour KMs	DFCC Chainage (in Km
1.	Nakhra SSP	696/23-25	149.111
2.	Adhwar SSP	Detour	180.137
3.	Birohi SSP	783/25-27	209.814
4.	Kotha SSP	Detour	242.180
5.	Chheoki SSP	877	268.990
6.	New Manauri SSP	905/1-3	302.302
7.	NewShujatpur SSP	935	332.292
8.	Khaga SSP	966-67	363.060
9.	Ramva SSP	997.76	396.070

10.	New Malwan SSP	Detour	428.214
11.	New Kanpur SSP	696/23-25	459.200
12.	Bhimsen SSP	Detour	488.200

2.1.9.2 Control and Monitoring of Traction Power System shall be via a dedicated Supervisory Control and Data Acquisition (SCADA) System.

2.2 Contract Packages for EDFC Phase-2

2.2.1 The work of EDFC Phase 2 has been divided in different contract packages as under:

Contract Package No.	Jurisdiction	Description
CP-201	Deen Dayal Upadhyay to New Karchana	Civil, Structure and Track
CP-202	New Karchana to New Bhaupur (excluding)	Civil, Structure and Track
CP-203R	Deen Dayal Upadhyay to New Bhaupur (excluding)	Signalling and Telecommunication
CP-204	Deen Dayal Upadhyay to New Bhaupur (excluding)	Electric Traction Power System and E&M Works

2.2.2 Main Line Route covered under Civil, Structure and Track (CST) Contract Packages(CP-201 and CP-202) are as below:

Contract Package	Existing Railway Km/(DFC Chainage)		Approx. Total Route Length	Remarks
	From	To		
CP-201	Km-669.670/ (Ch-119.550)	Km- /(Ch-278.155)	158.605 (DL) 22.430 (SL)	Parallel Length (DL)– 121.985 km Detour Length (DL) – 36.620 km Link Line Length(SL)- 22.430 Km
CP-202	Km– /(Ch.278.155)	Km– /(Ch-507.693)	229.538 (DL) 6.720(Km)	Parallel Length (DL) – 139.889 km Detour Length (DL) – 89.649 km Link Line Length(SL)- 6.720 Km

2.2.3 The Building and Civil Structure works of Station Buildings, Level Crossing Gate Lodges, IMDs, IMSDs, Residential Buildings, Club/Institute and Guest House are covered in Civil, Structure and Track (CST) Contract Packages(CP-201 and CP-202).

2.2.4 The work of 25 kV AC, 50 Hz, AT Feeding, Electric Traction Power System is covered under Contract Package CP-204.Control and Monitoring of Traction Power System shall be via a dedicated Supervisory Control and Data Acquisition (SCADA) System and is also covered under Contract Package CP-204.

2.2.5 The Building and Civil Structure works of Traction Sub-station (TSS), Sectioning Post (SP) and Sub-sectioning Post (SSP) is covered under Contract Package CP-204.

2.2.6 The work under scope of Contract Package CP-204 shall also include electrification of all Residential and Service Buildings of EDFC Phase-2(including S&T Service Buildings to be built under Contract Package CP-203R).

2.2.7 The provision of Mains Power Supply(from Local Supply, Up & Dn AT Supply & DG Sets) for Signalling & Telecommunication Systems at Stations, Level Crossing Gates, Auto Location Huts, GSM-R Locations, IMDs/IMSDs and Residential Complexes is covered Contract Package CP-204.

2.2.8 The Building & Structure and Electrical work of Centralized Operational Control Centre (OCC) for the entire Eastern Dedicated Freight Corridor, i.e. including EDFC Phase-2, has been constructed at Allahabad is covered under Contract Package CP-104.

2.2.9 The Backup Control Centre(BCC) is to be constructed in future at NOIDA. The work of BCC is not included in the scope of work Contract Packages of EDFC Phase-2(CP-201, CP-202, CP-203R& CP-204).

2.2.10 Civil, Structure and Track (CST) Contract Packages (CP-201 and CP-202) are planned to commence about 3 months ahead of Signalling& Telecommunication Contract Package (CP-203) and Electric Traction System Works under Contract Package (CP-204). Completion dates for the CST, Signalling& Telecommunication and Electrical contracts have been planned to be the same so as to facilitate integrated testing and commissioning of the entire section.

3.0 Objective

The objective of this Bid Document is construction of Signalling and Telecommunication system works for EDFC Phase-2 as a Design and Build Contract Package. This Signalling and Telecommunication system works for EDFC Phase-2 is being funded by Ministry of Railway.

4.0 Scope of Work in Brief

4.1 The work under the scope of this Contract (Contract Package CP-203R) consists of Balance works of Design, Manufacture, Supply, Construction/Installation, Testing and Commissioning of Signalling, Telecommunication and Buildings & Structures (The Service Buildings for Signalling and Telecommunication work in the Block Sections) on Design and Build lump sum basis for EDFC Phase-2. The details of Track Sections, Stations, LC Gates, Maintenance Depots, OCC, Service Buildings, Residential Buildings, Club/Institute, Guest House and Traction Power System covered under EDFC Phase-2 is given in Clause 2.0 above.

4.2 The Works shall be based on "Employer's Requirements and Specifications as detailed in General Specifications(Part 2, Section V) and the relevant Particular Specifications.

(1) Signalling Works

Particular Specifications of Signalling Works, including Train Management System is given in Volume 7, Part 2, Section V(B).

(2) Telecommunication Works

Particular Specifications of Telecommunication Works is given in Volume 8, Part 2, Section V(B).

(3) Building & Structures Works

Particular Specifications of Building & Structure Works is given in Volume 9, Part 2, Section V(B).

(4) Work already Executed

The details of work already executed/material supplied is given in Appendix-15 Volume 6, Part 2, Section V(A).

4.3 Temporary Work

The Contractor shall execute all Temporary Works required to facilitate construction/installation and the cost thereof shall be included in the overall bid price. All temporary arrangements and works shall be designed and necessary drawings developed to ensure safety during construction/installation. As a rule, Temporary Works shall be subsequently dismantled and removed by the Contractor after construction/installation, at his own cost. The Engineer, however, may permit/instruct retention of some of the Temporary Works with mutual consent between the Contractor and the Engineer.

4.4 Incidental Works

In addition to above the Contractor shall undertake various incidental Works to complete the entire project successfully. The Contractor shall include cost of such incidental Works in his Bid price. Some of the incidental Works are listed below:

(i) **Site Safety Compliance**: - The Bidder shall submit as part of his bid a Site Safety Plan which shall be in accordance with Part 2, Volume 6, Appendix-12 Site Safety Plan

(ii) **Quality Assurance:**-The Bidder shall submit as part of his bid a Quality Assurance Plan which shall include Quality Assurance procedures and regulations to be developed and the mechanism by which these will be implemented for ensuring Quality compliance as per the Employer's Requirements **detailed in Appendix 6, Volume 6, Part 2 of Bidding Document**.

(iii) **Interface Management**: - The Contractor for this Work shall cooperate and coordinate with Civil Engineering contractor as well as Track Contractor and shall bear the responsibility for Interface management for System works with other Contractors and agencies. After award of Contract the Contractor shall submit an Interface Management Plan which shall include procedures and regulations to be developed and the mechanism by which Interfacing will be implemented as per the Employer's Requirements detailed in **Appendix 3, Volume 6, Part 2 of Bidding Document**.

(iv) **Integrated Testing and Commissioning**:- The Contractor for this Work shall be required to conduct & extend all necessary help for Integrated test for the entire System in coordination with other Contractors and agencies to meet the requirements as mentioned in the Bid Document.

(v) In case, the management of traffic around the worksite becomes necessary, the Contractor shall carry out the same at his cost. The Engineer however, may at times request the Contractor to retain the temporary diversion of the road in place. All such requests by the Engineer shall be entertained by the Contractor.

(vi) While working in close proximity of existing IR track, the Contractor shall obtain permission for Works with or without traffic block from concern Railway authority/interfacing agencies wherever applicable and DFCC shall assist in obtaining such permits. Extra precautions to be observed by the Contractor while working in close proximity of existing Indian railway track as listed in **Volume 5, Manufacturing, supply, installation, testing & commissioning Part 2 Employer's Requirements**.

(vii) Benchmarking, setting out, photography, videography, report submission, permanent markers like cable markers, signages, boards etc. As Built drawings, inspection books, registers for record & maintenance of system works as specified in Section V(A) and V(B) **Part 2 Employer's Requirements.**

(viii) The Contractor shall be responsible for obtaining relevant certificates or clearances from local/civil authorities/Commissioner of Railway Safety viz. completion certificate, fire clearance or any other mandatory clearances which `may be specified by these authorities from time to time.

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Section V(A). Employer's Requirement:
General Specifications
Volume 2 – General

1.0 INTRODUCTION

1) The work under the scope of this bid consists of Balance works of design, supply, construction, installation, of Signaling& Telecommunication and associated works including testing and commissioning for double track electrified railway line on design build lump sum basis from Deen Dayal Upadhyay–New Bhaupur Section of Eastern Dedicated Freight Corridor. The Employer requires that these works are designed and constructed to the highest standard using proven upto date good practices.

2) The Employer's Requirement has been divided into two sections as under:

SECTION V (A): General Specification

Volume 1: Scope of Works
Volume 2: General
Volume 3: Design Procedures and Processes
Volume 4: Design Criteria and Specifications
Volume 5: Manufacturing, supply, installation, testing & commissioning
Volume 6: Appendices

SECTION V (B) : Particular Specification

Volume 7: Particular Specifications for Signalling works
Volume 8: Particular Specifications for Telecommunication works
Volume 9: Particular Specifications for Building and Civil Structure Works

2.0 DEFINITIONS AND INTERPRETATIONS

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

(a) **"As-Built Drawings":** means those drawings produced by the Contractor and endorsed by it as true records of construction of the Permanent Works and which have been agreed with the Engineer.

(b) **"Condition of Contract":** shall mean General Conditions of Contract (Section VI, Part 3) read in conjunction with Particular Condition of Contract as in **Section VII, Part 3 of Bid Document.**

(c) **"Construction 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.

(d) **Manufacture & Supply Phase and Installation, Testing, Commissioning phase:** has the meaning identified in Para 4 of Volume 2.

(e) **"Defect"** is any part of the Work which is not in accordance with the Contract.

(f) **"Definitive Design":** prepared and accepted part of drawings, documents, standards, and instructions, which give the abilities for supply, installation and testing. Giving clearance by the Engineer, to the Definitive Design is an obligatory condition for the commencement of construction Works. "Definitive Design" has the meaning identified in **Part 2 "Employer's Requirement, Section V A,**

Volume 3, Design Procedures and Processes" for Various Works of the Bid Document.

(g) **"Definitive Design Submission":** means the submission of Contractor's Documents which comprise the whole or parts of the proposed Definitive Design and for which the Contractor seeks a Notice.

(h) **"Design Criteria":** means the governing specifications and conditions as specified in Employer's Requirement Volume 4 and in **Section V (B) of Particular** Specification of Bid Document.

(i) **"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.

(j) **"Design Manual":** means the manual to be prepared and submitted by the Contractor as part of the Preliminary Design and as described in, **Part 2 "Employer's Requirement, Section V (A), Volume 3, Design Procedures and Processes"** of the Bid Document as applicable.

(k) **"Design Phase":** has the meaning identified in para 4 of this chapter.

(l) **"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.

(m) **"Drawings"** means the Employer's Drawings and the Drawings submitted by the Contractor and any modification of such drawings, if any, furnished from time to time, or for which the Engineer has issued a Notice of No Objection.

(n) **"Good for Construction Drawings ":** shall be derived directly from the Definitive Design and shall detail and illustrate in full the Permanent & Temporary Works. These drawings are the ones which the Contractor considers sufficient in detail for construction and is cleared by the Engineer for construction.

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

(p) **"Key Date"** means the date identified as such in the Contract **"Employer's Requirement, Section V (A), Volume 6, Para 2; Appendix 4 – Project Program Requirements"**.

(q) "**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.

(r) "**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.

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

(t) **"Milestone"** means as defined in clause 1.1.3.10 of GC

(u) **"Milestone Date"** means the date prescribed in Schedule of Milestones by which a Milestone is to be achieved - **Employer's Requirement, Section VI, Volume 6, Para 2; Appendix 4 – Project Program Requirements"**.

(v) **"Milestone Certificate"** means the certificate to be issued by the Engineer in relation to the achievement or otherwise of Milestones.

(w) **"Notice":** means a Notice of No Objection.

(x) **"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, submitted during Technical Proposal.

(y) **"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 safety as prescribed in the **Employer's Requirements Part 2**.

(z) **"Permanent Work''** means the permanent works to be designed and executed by the Contractor under the Scope of Work covered in this Contract.

(aa) **"Preliminary Design":** means the submission of Contractor's Documents which comprise the initial stage of the design phase.

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

(cc) **"Railway"** means Railway or any portion of a Railway for public carriage of passengers and goods as defined in the Railway Act 1989. Any reference to railway means the Indian Railways and the respective Zonal Railway.

(dd) **"Railway Envelope":** means the zone or zones within the Works which contain the track, platforms and equipment necessary for the operation of the railway by the DFCC.

(ee) **"Reference Drawings"** means the drawings prepared by the Employer and included in the bidding document.

(ff) **"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.

(gg) **"Safety Procedures":** these shall be the procedures as detailed in Part-2, Section –V (A)**, Volume-6, Appendix -12, Employer's requirement.**

(hh) **"Schedule of Milestones":** means the schedule included in sub clause 8.2 of Time for Completion **– Part 3,section VII of Bid Document**.

(ii) **"S&T Works": Signalling & Telecommunication (S&T) Works** means the work connected with design, construction, manufacture, supply, installation, testing and commissioning related with, Signalling and control systems, telecommunication system. E & M works, allied service buildings required for S&T works, removal of any temporary works as included in the scope of works.

(jj) "**Sub-system**" Each system comprises of sub systems. Signalling System comprise sub systems of Electronic Interlocking System, Train Detection System, Point Operation System, Absolute Block Working, Power Supply System, Train Management System and Level Crossing Interlock System.

Telecommunication System comprise sub systems of Optical Fiber Communication System, Data Networking System, GSM-R based Mobile Train Radio Communication System, Telephone System, Emergency Communication System, VHF Communication System, Master Clock System and 48 volt DC Battery Backup System etc.

(kk) **"S&T Contractor":** means the Contractor engaged by the Employer to carry out Works related to S&T part of the project mentioned above.

(ll) **"System Acceptance Tests''** means those tests that demonstrate the performance of the installation / equipment to the specified requirements as detailed in the Particular Specifications

(mm) **"Technical Specification":** 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, installation and construction-testing-commissioning which are developed during the Design Phase and fully comply with the Employer's requirements.

(nn) **"Works"** also 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 Materials and their accessories.

(oo) **"Work Station"** means the collection of processors, screens and input devices necessary to provide one controller or maintenance personnel with necessary system displays and commands.

(pp) **"Working Drawings":** comprise the drawings and documents, such as construction drawings, manufacturing drawings, installation drawings, and testing and commissioning documents as are necessary to amplify the Good for construction Drawings for construction etc. purposes and endorsed, as required, by the Engineer.

(qq) **"Works Programme"** means the programme showing the sequence, method and timing of investigations, design, issue of No Objection Notices, execution, manufacture, delivery to site, erection, installation, testing, commissioning of the Works (including Integrated Testing and Commissioning), indigenization (where applicable) and related activities in the form and content prescribed by the Employer's Requirements, or any amended or varied version thereof, as submitted by the Contractor and for which the Employer's Representative has issued a Notice of No Objection.

3.0 RELEVANT DOCUMENTS

These documents shall be read in conjunction with the Conditions of Contract (General and Particular), Employer's Requirement and any other document forming part of the Contract. This design-build contract shall be fulfilled, managed and commissioned in accordance with the applicable legislation in India, specific IR regulations and railway operations manuals and where none exist with applicable international norms where appropriate. Tentative list of standards is enclosed in **Part 2 "Employer's Requirement, Section V (A), Volume 6, Appendix 14 - Design Standards"**

4.0 DESIGN, MANUFACTURE, SUPPLY, INSTALLATION, TESTING AND COMMISSIONING

(1) The Contractor shall execute the works in four (4) phases;

(a) Phase 1- Design Phase
(b) Phase 2, The Manufacture & Supply Phase
(c) Phase 3, The Installation, Testing and Commissioning phase ; and
(d) Phase 4, the Defect Liability Phase.

(2) The Design Phase shall begin from the Commencement Date of the Contract. This phase shall include the preparation and submission of:
(a) the Preliminary Design and Drawings;
(b) the Definitive Design and Drawings;

(3) The Manufacture & Supply Phase (comprising the procurement, manufacture of plant, production of materials, testing, supply and delivery) for the whole or a part of the Permanent Works shall commence immediately upon the issue by the Engineer of a Notice in respect of the relevant Drawings Submission. Such Notice may be issued by the Engineer in respect of a Drawings Submission covering a major and distinctive part of the Permanent Works. .

(4) However, manufacture shall not commence until the original copies of the appropriate Working Drawings relating to manufacture have been endorsed by the:

(a) Contractor as "Good for Manufacture";
(b) Engineer that he has no objections to these drawings.

(5) The Manufacture and Supply Phase will be completed upon the issue of a Notice in respect of the comprehensive and complete Manufacture & Supply Verification Submission for the whole of the Permanent Works.

(6) The requirements for the procurement, manufacture of plant, production of materials, testing, supply and delivery are stated in **Volume 5 "Employer's Requirements Section V(A) Part 2. Manufacture, Supply, Installation, Testing & Commissioning and Section V(B) of Particular Specification.**

(7) The Installation-Testing-Commissioning Phase for the whole or a part of the Permanent Works shall commence immediately upon the issue by the Engineer of a Notice in respect of completion of the relevant Manufacture & Supply Verification Submission. Such Notice may be issued by the Engineer in respect of completion of manufacturing and supply of a major and distinctive element comprising part of the Permanent Works.

(8) However, installation shall not be commenced until the original copies of the appropriate Working drawings relating to installation at (7) above have been endorsed by the:

(a) Contractor as "Good for Installation";
(b) Engineer that he has no objections to the drawing;

(9) The requirements for installation, testing and commissioning and all associated activities (spares, training etc.), are stated in **Volume 5, "Employer's Requirements Section (A) Part 2. Manufacture, Supply, Installation, Testing & Commissioning"** and in **Section V (B) of Particular Specification.**

(10) The Installation-Testing-Commissioning Phase shall include the completion and submission of the Final Design and the preparation and submission of the As-Built Drawings and other records as specified.

(11) The defect liability phase shall commence immediately upon taking over of the section and issue of necessary certification thereof by the Engineer.

(12) This Notice may be in respect of each such element subject to availability of the site in accordance with agreed programme.

5.0 SPECIFICATIONS

(1) The Technical Specifications for the Works shall comply with Standards and Design Codes which are in accordance with or defined and listed in section V(A) & V (B) including outline materials and workmanship specifications if any.

(2) In accordance with the provisions of these documents, the Contractor shall develop the Technical Specifications during the Design stage and submit it as part of the Definitive Design Submission.

(3) When the Specifications have received a Notice of No Objection from the Engineer, these shall become the Technical Specifications.

6.0 UNIT OF MEASUREMENTS

The Contract shall utilize the SI system of units.

7.0 WORKS PROGRAMME

(1) The Contractor shall prepare and submit its Works Programme and three (3) months rolling programs as defined in the detailed requirements contained in **Part 2 "Employer's Requirement, Section V(A), Volume 6, Appendix 4 - Project Program Requirements"**.

(2) The Stages and the Key Dates are as defined in **Part 2 "Employer's Requirement, Section V(A), Volume 6, Appendix 2 - Works Areas and Contract Stages"** and are based on the Project Calendar as defined at **Part 2 "Employer's Requirement, Section V (A), Volume 6, Appendix 9 - Project Calendar"**.

8.0 MONITORING OF PROGRESS

(1) The Contractor shall submit to the Engineer **five** copies of a Monthly Progress Report (MPR) in English and on CD/DVD, as described in **Part 2 "Employer's Requirement, Section V (A), Volume 6 Appendix 5 - Monthly Progress Reports"**.

(2) Engineer will require the Contractor to attend monthly management meeting or any other meetings in order to review the arrangements for future Work, Works progress or other issues set out in the agenda of the meeting. The minutes of the meeting signed by the Contractor and the Engineer shall constitute an official record of matters discussed, but shall not replace any requirement in the Contract for approvals, instructions or decisions to be submitted in writing. Such meetings may be attended by representatives of all Interfacing Parties and other stakeholders as deemed fit by the Engineer or Employer at his discretion. The Employer may also be present in the meeting.

9.0 SITE SAFETY PLAN

(1) The Contractor shall establish and maintain various provisions of Site Safety Plan as detailed in **Part 2 "Employer's Requirement, Section V(A), Volume 6, Appendix 12**

10.0 QUALITY ASSURANCE

(1) The Contractor shall establish and maintain a Quality Assurance System in accordance with **Part 2 Employer's Requirement, Section V(A), Volume 6, Appendix 6 - Quality Assurance"** for the design, construction procedures and the interfaces between them.

(2) The Quality Assurance Plan shall, without limitation, include for quality assurance procedures for Design, Construction, Manufacturing, Supply, Installation, Testing and Commissioning and shall control processes for each stage in the Works such as for design verification and validation, management of change control, non-conformance procedures, inspection, testing, auditing and the like.

11.0 CO-ORDINATION WITH INTERFACING AND OTHER PARTIES

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

(2) For the purpose of these general specifications, Contractor's responsibilities are listed at **Part 2 "Employer's Requirement, Section V(A), Volume 6, Appendix 3 - Design and Construction Interfaces"** and in Particular specification, Section V(B).

12.0 SURVEY AND SITE INVESTIGATIONS

The Contractor shall carry out survey and all further site investigations as necessary for the design of the S&T related Works and to enable the determination of the methods of construction and the nature, extent and design of the Temporary Works.

13.0 PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)

The Contractor shall devise and utilize a PMIS such that all documents generated by the Contractor can be transmitted to the Engineer by electronic means. The PMIS shall also allow all documents generated by either party to be electronically captured at the point of origin and be reproduced later, electronically and in hard copy. Requirement of PMIS are explained in **Part 2 "Employer's Requirement, Section V (A), Volume 6, Appendix 4 - Project Program Requirements".**

14.0 PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHTS

In so far as the patent, copyright or other intellectual property rights in any Plant, Design Data, plans, calculations, drawings, documents, materials, 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, non-exclusive and irrevocable license to use and reproduce any of the Works, Designs or inventions incorporated and referred to in such plant, documents or materials 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.

15.0 LANGUAGE OF CONTRACTOR'S DOCUMENTS

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

16.0 ALIGNMENT& YARD PLANS

(1) The proposed alignment, yard plans listed in **Part 4 "Reference Documents."** are for reference purpose only.

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

(3) It will be presumed that Contractor has taken note of all effects of these constraints on his construction operations to ensure on-time completion of the Works.

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

17.0 CLEARANCES

The Permanent works shall not infringe the schedule of dimensions and land boundary limits of DFCC as shown on the drawings as listed in **Part 4:Reference Documents.**

18.0 CLIMATIC CONDITIONS

1. The entire section from New Bhaupur to Deen Dayal Upadhyay is situated in the state of Uttar Pradesh. During summer months the temperature can be as high as 45°C with a high level of humidity, nights can be relatively cool with temperatures dipping to 30°C. Torrential rains and high humidity accompany the monsoon in late June to early September. In the winter months temperatures can vary from a high of 21°C during day to a low of 2°C during night.
2. The information given above is only indicative. The contractor shall obtain detailed climatic data in respect of minimum & maximum temperatures, rain, relative humidity, sun shine, and wind velocity/pressure etc. from “India Meteorological Department publications” and the same shall be taken into account by the Contractor when designing any part of the Permanent Works. The Contractor shall ensure that due allowance is made for more severe local conditions when Permanent Works are required to operate, for example, with restricted ventilation that may lead to higher local ambient temperatures, and any other factors that may affect the operating environment in any way.
3. Unless specific figures are provided elsewhere, the Permanent Works will generally be required to function at its rated value with the values of ambient temperature and relative humidity appropriate to the location of the equipment within the classifications shown in Table given below. Certain parts of the Permanent Works may need to be rated for more or less onerous conditions as required by the Particular Specification (PS).
4. The Contractor’s attention is drawn to the more severe environmental conditions that may exist during the construction/installation period and shall take adequate measures to protect the Permanent works against any deleterious effects of such conditions during the time between installation and final completion of the project. Also, Air throughout the project will contain considerable moisture content, hence the permanent works shall be tropicalized and vermin proof.

5. Classification of Equipment Environment

(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.

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

(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.

(a) Requirements for Class A	
Minimum Temperature	5°C
Ambient Temperature	29°C
Maximum Temperature	35°C
Relative Humidity	Minimum 0%, Nominal 65%, Maximum 95% (Non Condensing)
Electrical Noise	High Frequency to 1MHz. 1kV damped to 50% after 6 cycles. Radio Frequency field strength 10 V/m, UHF & VHF bands.

(b) Requirements for Class B	
Minimum Temperature	-2.5°C (B1) and (B2)
Ambient Temperature	30°C (B1) and 50°C (B2)
Maximum Temperature	45°C (B1) and 55°C (B2)
Relative Humidity	Nominal 70%, Maximum 100% (Non condensing)
Air Quality	Polluted and dusty - SO_2:80-120mg/m3 Suspended Particulate Matter: 360-540mg/m3

Electrical Noise	Impulse 1kV, 1.2/50 rise/decay, 500Σ source impedance, 0.5J source energy.
Radio & High Frequency	as Class A.

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

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

19.0 STANDARDS

(1) Equipment, materials, and systems shall be designed, manufactured and tested in accordance with the latest issue as on base date of approved and recognized codes and standards as given in Part-2, Employer's Requirement, Section V (A), Volume 6 Appendix -14- Design Standards" and Section V(B) Particular Specifications . The contractor shall be responsible to adopt the latest version of these codes and standards including all amendments thereof.

(2) The Contractor shall provide to the Engineer two original full editions of the publications (such as, but not limited to, Technical Standards, specifications and Codes of Practice), the codes and standards proposed for carrying out the Designs, Contractor's Documents, the Drawings and other communications relevant to this Contract. The Contractor shall provide list of all such standards and specifications, which form the basis of his design activities within 28 days of Commencement Date. A copy of other publications referenced in other communications between the Engineer and the Contractor shall be provided by the Contractor to the Engineer within 28 days following the issue of such other communication. These publications shall be for the sole use of the Engineer and Employer and, upon completion of the Contract, shall become the property of the Employer.

20.0 PUBLICITY

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

Section V (A), Employer's Requirement:
General Specification
Volume 3 – Design Procedures and Processes

1.0 INTRODUCTION

(1) This document specifies the procedural requirements for the preparation of the Design.

(2) In addition to the requirements stated herein, the Contractor shall, whenever the Engineer so requests, provide information and participate in discussions that relate to Design matters.

(3) The Contractor shall, in accordance with Clause 5.1 of the General Conditions of Contract engage the designer(s) who shall undertake and prepare the Design of the Works.

(4) The Contractor shall establish an office for his core design team at a suitable location near Engineer's office. All meetings and discussions relating to design shall be held in that office or the office of Engineer/Office of Employer (either in Field or in HQ).

(5) The Contractor shall ensure that the Designer and his team continue to be represented in India(Project Design Office)by staff whose seniority and experience in their respective fields of activity, are to the satisfaction of the Engineer. The contractor shall also undertake that the designers shall be available to attend discussions with the Engineer and Employer at all reasonable times during the contract period.

(6) The key Designers who shall formally sign the Design must have the necessary qualification required by the applicable legislation in India, as well as their engineer's degree/diploma being recognized in India.

(7) The Contractor shall submit his Quality Assurance Plan for the Design required in the Contract as specified in "**Part 2 Employer's Requirement, Section V(A) , Volume 6,Appendix 6 - Quality Assurance".**

(8) The contractor shall submit CV of all the concerned personnel of Key Position to the Engineer for approval, whose designation have been mentioned in bid document, before deputing them at project site.

2.0 REQUIREMENTS DURING THE DESIGN PHASE

(1) The principal requirements of the Design Phase are the production of the documents by the Contractor, which shall fully describe the Works and include the Preliminary Design, Definitive Design and "Good for Construction Drawings".

(2) The volume and contents of the documents shall be in accordance with the applicable regulations/legislation in India, existing codes, manuals and standards applicable on Indian Railways and suitable international norms.

(3) The Contractor shall obtain all necessary approvals and agreements for his designs on his account in accordance with the applicable legislation in India & current practices.

(4) The Preliminary Design shall incorporate the design and Reference Drawings included in the Bid Document, and to be developed by the Contractor sufficiently to define the S&T related works.

(5) In addition, general construction, manufacture, installation, testing and commissioning methodologies and documentation needed to develop the Definitive Design shall be submitted.

(6) The Definitive Design shall accord with, and incorporate the Contractor's Proposals and shall be the design developed to the stage at which all elements pertaining to

Works are fully defined and specified. In particular the Definitive Design shall be complete when:

(a)All calculations and analyses are complete including verification;

(b) All main and other significant elements are defined;

(c) All tests, trials and selection of materials and equipments are complete;

(d) The effects on the Permanent Works of the proposed methods of construction, installation, testing and commissioning and on the Temporary Works are assessed.

(7) During the preparation of the Definitive Design, all surveys, and testing necessary to complete the Design of the Permanent and Temporary works shall be undertaken by the Contractor.

(8) Two hard and soft copy of the Design of S&T related works shall be submitted for approval to the Engineer. After approval of the definitive design of S&T works, three additional hard copies in a bound book form and one softcopy should be provided by the Contractor.

(9) After approval of the Engineer the Contractor may proceed to the next stage of the Project for obtaining notice of No Objection.

(10) Upon issue of the Notice in respect of the Definitive Design Submission, the Contractor shall complete the Design in all respects and produce the "Good for Construction Drawings", the purpose of which is to illustrate all the Permanent works and to be the drawings governing the Construction.

(11) These drawings shall fully detail the Construction of the elements covered by the Definitive Design, and shall show in full, the Works to be constructed.

(12) The Contractor shall prepare the necessary sets of his designs in English for submitting to the relevant authorities responsible for the approvals in accordance with the contractual provisions & the applicable legislation in India.

(13) Detailed requirement of design phase for various systems components is given in part 2 section V(B), Particular Specifications.

3.0 REQUIREMENT FOR ALIGNMENT AND LAND

The contractor is to develop the definite design within the function completed and the land acquired or proposed to be acquired by the employer for the project as applicable.

4.0 REQUIREMENTS DURING CONSTRUCTION PHASE

(1) The principal requirements relating to the Contractor's documents during the Manufacture, Supply, Installation, Testing and Commissioning Phase are the production by the Contractor of Working Drawings and documents, the preparation of technical submissions as required under the Contract, the compilation of the final design and the production of the As-Built Drawings and final documentation.

(2) Working Drawings and documents shall be prepared as required under the Contract.

(3) The Contractor shall endorse the Working Drawings and documents as being in accordance with the Definitive Design and "Good for construction drawings".

(4) Additionally the requirements of **Volume 5, "Employer's Requirements/ Performance Specifications, Section V(A) Manufacturing, Supply, Installation,**

Testing and Commissioning" and Section V(B), Particular Specifications are to be complied with.

(5) The Contractor shall endorse the submissions required under the contract that "all effects of the designs comprising the submission, on the design of adjacent or other parts of the works have been fully taken into account in the design of these parts".

(6) The final design is the design of the Permanent Works embodied in:

(a) The latest revisions of the documents comprising the Definitive Design, taking account of comments in the schedules appended to Notices of No Objection;

(b) The latest revisions of all the drawings;

(c) The calculations (see **Clause 13.0 Calculations** herein); and

(d) Such other documents as may be submitted by the Contractor at the request of the Engineer to illustrate and describe the Permanent Works and for which a Notice has been issued.

(7) Upon completion of the Works or at such time as agreed to or required by the Engineer, the Contractor shall prepare drawings which, subject to the Engineer's agreement, shall become the As-Built Drawings and final documents.

(8) All such drawings and documents shall be endorsed by the Contractor as true records of the construction of the Permanent Works and of all Temporary Works that are to remain on the site.

(9) Where the Contractor temporarily requires additional land, for the period of construction to facilitate the construction, the contractor shall arrange for the same entirely at his own cost and risk.

(10) The Contractor shall maintain all records necessary for the financial completion and commissioning. These records shall form part of completion report and shall consist of as a minimum.

(a) The implemented work according to activities, places and price;

(b) Used materials – type, name of manufacturer along with batch No., Drg No. Specification no., place& price etc;

(c) Any other records as required.

5.0 DESIGN INTERFACES WITH INTERFACING CONTRACTORS

(1) The Contractor shall be responsible for all co-ordination of all design and installation work with the various interfacing parties including interfacing contractors, to establish the Co-ordinate Interface Plan (CIP) as defined at **Part 2 "Employer's Requirement, Section V (A), Volume 6, Appendix 3 - Design and Construction Interfaces"**.

(2) The CIP shall be prepared by the Contractor in a format acceptable to the Engineer.

(3) The Contractor shall co-ordinate with all Interfacing Contractors and Parties to produce a detailed programme of access dates, equipment delivery routes and occupation periods for each equipment room and area inside the Railway envelope.

6.0 PLANNING SUBMISSION

Submission for approval of planning of works for the project shall be made by the contractor to the relevant authorities.

7.0 DESIGN SUBMISSION

The Design Submission shall be a complete set of Contractor's documents properly consolidated and indexed and shall fully describe the proposed Design.

7.1 Preliminary Design Submission

The Preliminary Design shall provide initial design documents for review of all elements of construction and shall be sufficiently detailed to show the elements of the design and documents required for preparation of the Definitive Design. The preliminary design should take into account as far as possible all the interface requirements identified by the Contractor at this stage. It shall also include, but not be limited to:

7.1.1 General

a) The quality assurance plan for design;
b) A review of the outline design criteria;
c) The Design Manuals;
d) Submission of specifications proposed for the work;
e) The identification of design codes and standards;
f) The preliminary maintenance analysis;
g) The preliminary off site testing recommendations;
h) The preliminary testing and commissioning report;
i) The submission of proposed software;
j) The CAD procedures;
k) The preliminary equipment layouts and details;
l) Preliminary equipment sizing;
m) Preliminary equipment proposals;
n) Preliminary installation and construction methodology;
o) Design submission programme (update);
p) Proposed site surveys and other field surveys.

7.2 Definitive Design Submission

The Definitive Design Submission shall be a complete set of Contractor's documents, properly consolidated and indexed and shall:

(a) Fully describe the proposed Definitive Design;
(b) Provide substantiation and justification for the recommended design, including the consideration of a range of options;
(c) Be submitted in sufficient time to allow the Engineer to consider and approve prior to the commencement of manufacture and/or installation;
(d) Prove that the design complies with all relevant design, performance, functional and other requirements as are specified or implied in the Tender Documents, under normal and all applicable degraded/failure modes.

7.3 Documents Submission

The Contractor's technical proposals shall be amplified during the Preliminary and Definitive Design as required above and shall include but not be limited to the following documents:

7.3.1 Technical specifications

(1) The Specifications included in the Contractor's technical proposals together with the Design criteria shall be amplified so as to comprehensively specify the design and construction of the Works.

7.3.2 Design Manual

(1) The Design Manual shall incorporate all design requirements, standards, codes and all other documents or matters which are relevant to and govern the design.

(2) In addition it shall refer to all materials, codes and standards used, making clear their specific applications.

(3) The Design Manual shall be produced so that it can be used by those involved in the preparation or review of the design of the Permanent Works as a comprehensive reference text and efficient working document.

7.3.3 Report on interfacing contracts

(1) The report shall include details of the Design and Construction of the Works sited adjacent to other contracts, details of provisions required to be provided by the Interfacing Contracts, indicating arrangements for accesses, fixings, casting-in, openings, supports, decks, manholes, trenches and the like, equipment installation in other Interfacing Contractor's works along with updated interface management plan relating to design integration and co-ordination.

7.3.4 Testing and commissioning reports

The report shall include details of proposals for testing and commissioning procedures for all relevant elements and equipment contained in the Permanent Works.

7.3.5 Maintenance reports

The report shall be updating the statement of maintainability in the Contractor's technical proposals and detailing maintenance routines necessary for the achievement of the required life of the various elements of the Works.

7.3.6 Supporting documents

Where relevant or required, these documents shall be accompanied by a design note stating clearly how the information has been used in the design of the Permanent Works.

7.3.7 Construction / manufacturing / installation analysis reports

A report shall be containing a stage-by-stage construction / manufacturing / installation sequence for all structures/ equipment.

7.3.8 Construction method statements

A report shall provide sufficient information on the methods of Construction / Installation of the Contractor's Equipment to allow the Engineer to assess their effects on the Permanent Works and to enable these to be taken into account in the review of the Definitive Design.

7.3.9 Survey report

The report shall cover all survey work undertaken by the Contractor.

7.3.10 Temporary works design report

The report shall provide sufficient information on the design of the Temporary Works to allow the Employer's Representative to assess their effects on the Permanent Works and to enable these to be taken into account in the review of the Definitive Design.

7.3.11 Project schedule review

(1) The Contractor shall, prior to submitting the Design Submission, review the project schedule against the current version of the Design Submission Programme.

(2) The Design submission programme should be in accordance with the Project Schedule.

(3) In the event that the Contractor considers there to be any discrepancies or inconsistencies between the design submission programme and the project schedule, the Contractor shall submit with the Definitive design submission programme, its proposed revisions to the project schedule such that the discrepancies or inconsistencies are removed.

(4) The Contractor shall provide details of submissions of the proposed Working Drawings and documents and their anticipated timing during the construction phase.

(5) The Contractor shall identify information required from or actions to be undertaken by the Employer or others and which are necessary to permit the completion of the design of the Permanent Works and the Working Drawings and documents.

(6) Dates of the receipt required by the Contractor of such information or for the completion of such actions shall be included with appropriate justification.

8.0 DESIGN SUBMISSIONS – GOOD FOR CONSTRUCTION DRAWINGS

(1) These drawings shall form part of the Working Drawings to be used for construction purposes.

9.0 DESIGN SUBMISSIONS – MANUFACTURE, SUPPLY, INSTALLATION, TESTING & COMMISSIONING PHASES

(1) In accordance with the **Volume 5. "Employer's Requirements Section V(A) Part 2 Technical Requirements, Manufacture, Supply, Installation, Testing and Commissioning" and Section V(B), Particular Specifications,** the Contractor shall identify submissions required during the Manufacture & Supply and Installation-Testing-Commissioning Phases.

(2) On the issue of a Notice in respect of the Good for Construction Drawings, the Contractor shall produce the proposed Working Drawings.

(3) These shall either be identical to the Good for Construction Drawings or shall be further drawings and documents developed in accordance with these drawings such as fabrication and shop drawings, construction installation and erection sequences and the like and all such drawings shall comply with the requirements of the Contract.

(4) Prior to submission of the proposed Working Drawings, the Contractor shall endorse the appropriate original paper drawings as "Good for Construction".

(5) If the Engineer so requires, the endorsed original shall be submitted to the Engineer who shall, if he has no objection to the contents of the submission, further endorse the original by stating that he has no objection to the proposed Working Drawings.

(6) On the endorsement by the Engineer, the original will forthwith be returned to the Contractor as the Working Drawings.

(7) Only the Working Drawings endorsed as above or those that the Engineer has expressly stated as not requiring his endorsement shall be issued to the Site and the construction of the Works shall be strictly in accordance with these Working Drawings.

(8) The manufacturing and installation of the Works shall be strictly in accordance with these Working Drawings

(9) The Contractor shall finalise details of the proposed method of construction and/or installation and submit such finalised details to the Engineer for review.

(10) As-built Drawings and documents shall be submitted to the Engineer for approval within the time period as mutually agreed by the Engineer and the Contractor.

10.0 DESIGN SUBMISSIONS - REVIEW PROCEDURES

(1) Design submissions shall be reviewed by the Engineer who shall coordinate the design review for the Employer and communicate the decision within 28 days of receipt of complete information on the subject matter.

(2) The Contractor shall, prior to the submission of the Design Data, obtain all required and/or statutory approvals that relate to that submission including, where appropriate,

the approval of the concerned government authorities and municipalities and utility undertakings, and demonstrate that all required approvals have been obtained.

(3) All submissions for Temporary and Permanent Works shall be accompanied by two original copies of a `Design Certificate' as set out in **Part 2 "Employer's Requirement, Section V(A), Volume 6,Appendix 11 – Design Certificate"** hereto and signed by the Contractor and the Designer.

11.0 DESIGN SUBMISSION PROGRAMME

(1) The Contractor shall prepare the Design submission programme which is to set out fully the Contractor's anticipated programme for the preparation, submission and review of the design packages, the Definitive Design Submission and the Good for Construction Drawings submission.

(2) The Design submission programme should be in accordance with the Project Schedule.

(3) The Design Submission Programme shall:

(a) Be consistent with and its principal features integrated into the Works Programme, and show all relevant Milestones and Key Dates;

(b) Identify dates by and subjects for which the Engineer's decisions should be made;

(c) Make adequate allowance of 28 days for periods of time for review by the Engineer and other review bodies;

(d) Make adequate allowance of 28 days for the Design and development of specialist works;

(e) Include a schedule identifying, describing, cross-referencing and explaining the Design Packages into which the Contractor intends to divide the Definitive Design and Good for Construction Drawings; and

(f) Indicate the Design Interface and Co-ordination periods for each Interfacing Contractor.

(4) The Contractor shall submit the Design Submission Programme to the Engineer within twenty eight (28) days of the Commencement Date, and thereafter up-dated versions thereof at intervals of not more than twenty eight (28) days throughout the Design Phase.

(5) The Construction and Defect Notification Period shall be as indicated in the Conditions of Contract. The Contractor shall be required to plan the various components of work in such a sequence that the entire work is completed within this time frame. Defect Notification Period shall commence after issue of Taking Over Certificate by the Engineer. Before commissioning of the complete rail system, Integrated Testing of the complete rail system will be done, as mentioned in the Contract. Contractor's Design submission programme shall consider all these aspects.

(6) The Contractor shall submit complete set as approved "As-Built" Drawings and certificates for conclusion of any legislative procedures.

12.0 SUBMISSIONS PROGRAMME DURING THE MANUFACTURE, SUPPLY, INSTALLATION, TESTING AND COMMISSIONING PHASE

(1) The Contractor shall identify submissions required during the Manufacture, Supply, Installation, Testing and Commissioning Phase in accordance with **Part 2 "Employer's Requirement, Section V(A) and V(B)"**.

13.0 CALCULATION

(1) Comprehensive set of calculations relevant to the Construction proposals, Definitive Design and Good for Construction Drawings and any Design change shall be submitted for review with the respective Design packages in soft as well as hard copies.

(2) The Engineer may require the submission of applicable software including in house software programmes/ worksheets developed by the Contractor, computer input and programme logic for its review prior to the acceptance of the computer output.

(3) Calculations to be included as part of the submission herein shall comprise the up-to-date calculations in respect of the Definitive Design, the Good for Construction Drawings and such further calculations which the Contractor has prepared during the production of Working Drawings.

14.0 DOCUMENT REQUIREMENT

(1) Drawings shall be prepared on CAD to the sizes as stipulated in **Part 2 "Employer's Requirement, Section V(A), Volume 6,Appendix 7 – Drawings and CAD standards"**.

(2) The titles & numbering scale of drawings shall be as per relevant Indian Railway Manuals/IS Standards as well as above CAD standards to be decided mutually by the Contractor and the Engineer. In all drawings as far as possible only such symbols as are in international use, shall be used.

(3) All designs, legends notes on drawings and schedules of materials shall being English and shall be prepared in the metrics system.

(4) The Contractor shall submit 4 hard copies and a soft copy of the Definitive Design and drawings including calculations for review by the Engineer. After receipt of the Notice from the Engineer, the Contractor shall submit 4 hard copies and a soft copy of the final Design and drawings for the use of the Engineer.

(5) The approval of drawings shall however be certified on the hard copy only.

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Section V (A). Employer's Requirement: General Specifications

Volume 4 – Design Criteria and Specifications

1.0 GENERAL DESIGN CRITERIA

1.1 Durability and Maintenance

(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 Design Criteria and standards contained in the technical specifications to minimize the cost of operation and maintenance whilst not compromising safety or the performance characteristics of the railway.

(2) Equipment where supplied shall be of a quality and durability to fully meet the performance and operational requirements described in the Design Criteria.

1.2 Operational Requirements

(1) The Permanent Works shall be designed to permit the railway to operate satisfactorily at a maximum speed for freight trains as per PS.

(2) The Contractor's attention is invited to the requirements concerning the role of the Commissioner of Railway Safety (CRS) and Electrical Inspector to Govt. Of India (EIG) as mentioned in **relevant Para of bid document**. Sanction of CRS may also be required in terms of Chapter XIII of IRPWM.

(3) It is a requirement that the Indian Railway (IR) remains operational during the construction phase.

1.3 Responsibility for the S &T Works

(1) The Contractor shall be responsible for detailed design, layout, construction, manufacture, supply, installation, testing and commissioning of the S&T Works wherever applicable under this Contract.

(2) The Contractor undertakes that the designers shall be available to attend discussions with the Engineer and Employer at all reasonable times during the Contract period.

(3) The Designer shall be the same entity as proposed by the Contractor at the time of pre-qualification, unless otherwise approved by the Employer. The Contractor shall furnish Designer's Warranty in the format provided **in contract forms of Bid Document.**

(4) The Contractor shall be fully responsible, for the suitability, adequacy, integrity, durability and practicality of the Contractor's proposal.

(5) Wherever there is any inadequacy, insufficiency, impracticality or unsuitability in or of the Employer's Requirements or any part thereof, the Contractor's proposal shall take into account, address or rectify such inadequacy, insufficiency, impracticality or unsuitability.

(6) The Contractor shall certify that:-

- The Works have been or will be designed, manufactured, installed and otherwise constructed and to the applicable standards available using proven up-to-date good practice.
- The Works will, when completed, comply with enactments and regulations relevant to the Works.
- The design of the Works have taken or will have taken full account of the effects of the intended manufacturing and installation methods, Temporary Works and Contractor's equipment.

(7) The Contractor shall also provide an undertaking from the Designer for his Designs for suitability, adequacy, practicality and absolutely meeting the Employer's Requirements as detailed in **Appendix 11 – Volume 6 Part 2 of Bid Document**. The undertaking shall also state that reasonable skill and care expected from a professionally qualified and competent designer experienced in works of similar nature has been exercised. This shall be

applicable for such Designs which may be or have been prepared, developed issued by the Employer, or any of Contractor's consultants, his sub-Contractors and/or his qualified personnel/persons or cause to have been prepared, developed or issued directly or indirectly by the Contractor.

(8) All the aforesaid shall be applicable notwithstanding the fact that any part of the work may have been inadvertently accepted, passed and paid for by the Engineer or Employer.

1.4 Aesthetics

(1) The Permanent Works shall be designed to achieve an aesthetic character and provide a feeling of design commonality throughout the project.

1.5 Safety Considerations

(1) The design of the Permanent Works shall be according to Indian laws and regulations related to Safety Requirements.

(2) Safety aspects shall be kept in mind during the Design/Construction and Testing & Commissioning phase, requirement for which has been specified at appropriate places in the bidding document as well as in **Part 2 "Employer's Requirement, Section V, Volume 6 Appendix 12 ".** It shall be the overall responsibilities of the Contractor to ensure compliance of Safety aspects at all times conforming to the provisions mentioned in this Bidding document.

1.6 Quality Control

Quality control aspects shall be kept in mind during the Design/construction and testing & commissioning phase, requirement for which has been specified at appropriate places in the bidding document as well as in **Part 2 "Employer's Requirement, Section V, Volume 6, Appendix 6 - Quality Assurance"**. It shall be the overall responsibilities of the Contractor to ensure deliverables of quality products at all times conforming to the provisions mentioned in this bidding document.

2.0 DESIGN CRITERIA AND TECHNICAL SPECIFICATION FOR WORKS

Design criteria and the specification for works shall be as per section V (B) Vol.7, Vol.8 and Vol.9 of Particular specification as under:

SECTION V (B): Particular Specification

Volume 7: Particular Specifications for Signalling works
Volume 8: Particular Specifications for Telecom works
Volume 9: Particular Specifications for Building and Civil Structure Works

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PART 2 Section V(A) Employer's Requirement
General specification
Volume 5

Manufacturing, Supply, Installation, Testing & Commissioning

19.9	Fault Log
19.10	Hardware Failure Report
19.11	Software Failure Report
20.0	RECORD
20.1	Records of Tests and Reports
20.2	Drawings produced by the Contractor
20.3	Progress Photographs and Videography
20.4	Records of Wage Rates
21.0	DEFECT NOTIFICATION PERIOD
22.0	OPERATION & MAINTENANCE SUPPORT PLAN
23.0	OPERATION AND MAINTENANCE (O&M) MANUALS
24.0	SPARES, SPECIAL TOOLS, TEST EQUIPMENT AND M & P
25.0	TRAINING

1.0 CONTRACTOR'S SUPERINTENDENCE

(1) The Contractor shall submit a staff organization plan in accordance with the bidding document along with the details of the qualifications and experience of all proposed staff to the Engineer for his approval. This plan shall be updated and resubmitted whenever there are changes to the staff.

(2) The plan shall show the management structure and state clearly the duties, responsibilities and authority of each staff member.

(3) The contractor shall submit CV of all the concerned personnel of Key Position to the Engineer and seek his approval, whose designations have been mentioned in bid document, before deputing at project site.

2.0 CONTRACTOR'S TEMPORARY WORKS DESIGN

(1) The Contractor shall, prior to commencing the construction of the Temporary Works, submit a certificate to the Engineer signed by him certifying that the Temporary Works have been properly and safely designed and checked and that the Contractor has checked the effect of the Temporary Works on the Permanent Works and has found this to be satisfactory.

3.0 THE SITE

3.1 General

(1) Site details furnished by the Employer are those as identified in **Part 4 "Site Data – Reference Documents"**.

3.2 Use of the site

(1) The Site as well as Contractor's Equipment shall not be used by the Contractor for any purposes other than for carrying out the Works, except that, with the consent in writing of the Engineer.

(2) All materials and equipment stored on Site shall be adequately protected against loss or damage due to any cause such as climatic effects, vandalism, shock and vibration, etc. according to the nature of the articles stored and the local Site condition.

3.3 Access to the site

(1) Access to the Railway Envelope by the Contractor shall be in accordance with any procedures, requirements and conditions defined in **Part 2 "Employer's Requirement, Section V(A), Volume 6, Appendix 4 - Project Program Requirements"**.

3.4 Clearance of the site

(1) All Temporary Works which are not to remain on the Site after the completion of the Works shall be removed after approval by the Engineer.

(2) The Site shall be cleared and reinstated as stated in the Contract.

4.0 SURVEY

(1) A site survey shall be carried for entire Site to establish its precise alignment and the various levels and features within it.

(2) On or before the Contractor is granted access to a certain portion of the Site, the Contractor shall carry out a survey jointly with the Other Contractors executing works on that portion of the Site. The Contractor shall advise the Engineer of the date of the joint survey at least 1 week in advance of the date.

(3) The survey shall be carried out before the site clearance wherever possible and in any case prior to the commencement of work in any Works Area.

(4) The plan for survey as well as the final report of the survey shall be made by the Contractor and agreed by the Engineer.

5.0 SAFETY MEASURES

(1) The Contractor shall be fully responsible for the safety of the Works, his personnel, subcontractors' personnel, the public and all persons directly or indirectly associated with the Works or on or in the vicinity of the Site.

(2) The Contractor shall treat safety measures as a high priority in all his activities throughout the execution of the Works.

(3) The project site safety requirements have been provided in **Part 2 "Employer's Requirement, Section V(A), Volume 6, Appendix 12 - Site Safety Plan"**.

(4) The Contractor shall comply with these requirements provided that the standards set out in the Project Site Safety requirements and Contractor's Site Safety plan shall be regarded as the minimum to be achieved and shall not relieve the Contractor of any of his statutory duties or his responsibilities under the Contract.

(5) The provisions of the Contract regarding safety shall apply to and be binding upon the Contractor for any part of the Works and the persons employed by sub-contractors of any tier.

(6) The Engineer reserves the right to order the immediate removal and replacement of any item of Contractor's Equipment or Temporary Works which, in his opinion, is unsatisfactory for its purpose or is in an unsafe condition.

6.0 CARE OF THE WORKS

6.1 General

(1) Unless otherwise permitted by the Engineer all work shall be carried out in dry conditions.

(2) The Works, including materials for use in the Works, shall be protected from damage due to exposure of weather condition, including ingress of water.

(3) Water on the Site and water entering the Site shall be promptly disposed of.

(4) The methods used for keeping the Works free of water shall be such that settlement of, or damage to, new and existing structures do not occur.

6.2 Protection of the works from weather

(1) Work shall not be carried out in weather conditions that may adversely affect the Works unless proper protection is provided to the satisfaction of the Engineer.

(2) Permanent Works, including materials for such Works, shall be protected from exposures of weather conditions that may adversely affect such Permanent Works or materials.

(3) During construction of the Works storm restraint systems shall be provided where appropriate.

(4) These systems shall ensure the security of the partially completed and ongoing stages of construction in all weather conditions.

(5) The Contractor at all times shall plan and execute the Works and make all protective arrangements such that the Works can be made safe in the event of storms.

6.3 Protection of the completed work

The finished works shall be protected from any damage that could arise from any activities on the adjacent site/ works, water inflow etc.

7.0 DAMAGE AND INTERFERENCE

(1) Work shall be carried out in such a manner that there is no damage to or interference with:

a) watercourses or drainage systems;

b) utilities especially those pertaining to train operations of existing IR system like working signalling, telecommunication, civil, mechanical, electrical etc. ;

c) structures (including foundations), roads, or other properties;

d) public or private vehicular or pedestrian access;

e) monuments, trees, graves or burial grounds other than to the extent that is necessary for them to be removed or diverted to permit the execution of the Works.

(2) Heritage structures shall not be damaged or disfigured on any account.

(3) The Contractor shall inform the Engineer as soon as practicable of any items which are not stated in the Contract to be removed or diverted but which the Contractor considers need to be removed or diverted to enable the Works to be carried out.Such items shall not be removed or diverted until the consent of the Engineer to such removal or diversion has been obtained.

(4) Items which are damaged or interfered with as a result of the Works and items which are removed to enable work to be carried out shall be reinstated to the satisfaction of the Engineer and to at least the same condition as existed before the work started.

(5) Contractor shall use cable route locator to identify cables within the zone of construction, and ensure its safety during construction activity. If required these be relocated/removed as detailed in Para 9.0 below.

(6) Any claims by Utility Agencies due to damage of utilities by the Contractor shall be borne by the Contractor. The contractor shall negotiate a settlement in respect of such claims and indemnify the Engineer and the Employer in respect of all claims, proceedings, damages, costs, charges and expenses in relation thereto.

8.0 UTILITIES

Manner of dealing with all types of utilities are defined in **Part 2 "Employer's Requirement, Section V(A), Volume 6, Appendix 1 - Utilities".**

9.0 STRUCTURES, ROADS AND OTHER PROPERTIES

9.1 General

(1) The Contractor shall immediately inform the Engineer of any damage to structures, roads or other properties.

9.2 Access

(1) Alternative access shall be provided to all premises if interference with the existing access, public or private, is necessary to enable the Works to be carried out.

(2) The arrangements for the alternative access shall be as agreed by the Engineer and the concerned agency.

(3) Unless agreed otherwise, the permanent access shall be reinstated as soon as practicable after the work is complete and the alternative access shall be removed immediately as it is no longer required, and the ground surfaces reinstated to the satisfaction of the Engineer. "

(4) Where ever required service road for construction activity, connectivity to the existing road network for the sake of Works has to be made by the Contractor and no extra payment shall be made for the same.

(5) Proper signage and guidance shall be provided for the traffic / users regarding diversions.

9.3 Trees

Manner of dealing with removal of trees from the alignment are defined in **Part 2 "Employer's Requirement, Section V(A), Volume 6, Appendix 1 - Utilities"**.

9.4 Removal of graves and other obstructions

If any graves and other obstructions are required to be removed in order to execute the Works, the Contractor shall draw the Engineer's attention to them in good time. Similarly if there are any permanent structures other than those defined in the utilities, Para 9.0 above, these shall be brought to the notice of Engineer in good time to allow all necessary arrangements and authorization for such removal. Contractor shall not itself remove them unless the Engineer has given consent. The modalities of removal shall be after mutual discussion between the Contractor and the Engineer.

9.5 Protection of the adjacent structures and works

(1) The Contractor shall take all necessary precautions to protect the structures or works being carried out by others adjacent to and, for the time being, within the Site from the effects of vibrations, undermining and any other earth movements or the diversion of water flow arising from its work.

(2) All operations for the execution of the Works shall be carried out so as not to interfere unnecessarily with the convenience of the public or the access to public or private roads or footpaths or properties owned by the Employer or by any other person.

(3) If during the execution of the Works, the Contractor receives any claim arising out of the execution of the Works in respect of damage to highways or bridges etc., he shall immediately report the facts to the Engineer. The Contractor shall negotiate a settlement in respect of such claims and indemnify the Engineer and the Employer in respect of all claims, proceedings, damages, costs, charges and expenses in relation thereto.

10.0 USE OF ROADS AND FOOTPATHS

10.1 General

(1) Public roads and footpaths on the Site in which the work is not being carried out shall be maintained in a clean and usable condition.

(2) Measures shall be taken to prevent the excavated materials, silt or debris from entering gullies on roads and footpaths; entry of water to the gullies shall not be obstructed.

(3) Surfaced roads on the Site and leading to the Site shall not be used by tracked vehicles unless protection against damage is provided.

(4) Contractor's Equipment and other vehicles leaving the Site shall be loaded in such a manner that the excavated material, mud or debris will not be deposited on roads.

(5) All such loads shall be covered or protected to prevent dust being emitted.

(6) The wheels of all vehicles shall be washed when necessary before leaving the Site to avoid the deposition of mud and debris on the roads.

10.2 Reinstatement of public roads and footpaths

(1) Temporary diversions, pedestrian access and lighting, signing, guarding and traffic control equipment, if any, shall be removed immediately when they are no longer required.

(2) Roads, footpaths and other items affected by temporary traffic arrangements and control shall be reinstated to the same condition as existed before the work started or as permitted by the Engineer immediately after the relevant work is complete or at other times permitted by the Engineer.

(3) The Contractor shall submit his design for the reinstatement to the relevant authorities and obtain their prior approval to carry out the work.

(4) Reinstatement works shall include:

a) Footpath and Kerbs
b) Road Signage
c) Street Lighting
d) Landscaping
e) Traffic Lights and Control Cable
f) Road painting
g) Telecommunication Tower/Cables

11.0 SITE ESTABLISHMENT

11.1 Site Laboratories

(1) The Contractor shall provide, erect and maintain in a clean, stable and secure condition a laboratory, equipped for the routine testing of concrete, soil and for the storage and curing of concrete cubes or cylinders only. The Lab should have provision of testing/measurement of acidity/BDV of transformer oil, tensile testing, relay testing etc. as per the requirement of work.

(2) This laboratory shall be located at the Contractor's principal work site or at a location agreed to by the Engineer.

11.2 Contractor's site accommodation

11.2.1 General

(1) The Contractor shall provide and maintain its own site accommodation at locations consented to by the Engineer. Offices, sheds, stores, mess rooms, garages, workshops, latrines and other accommodation on the Site shall be maintained in a clean, safe and secure condition.

(2) The Employer will not provide living accommodation for the use of the Contractor or any of his staff or labour employed on the Works.

(3) Living accommodation shall not be established on any land provided to the Contractor by the Employer without prior approval of the Engineer.

11.2.2 Provision of Labour Camp

(1) The Contractor shall, at his own expense, make adequate arrangements for the housing, supply of drinking water and provision of bathrooms, lavatories and urinals, with adequate water supply, for his staff and workmen.

(2) No Labour camp shall be allowed at any Work site or at any unauthorized place.

(3) The Contractor at his own cost shall maintain all camp sites in a clean and hygienic condition.

(4) The Contractor shall obey all health and sanitation rules and regulations, and carry out at his cost all health and sanitary measures that may from time to time be prescribed by the local/medical authorities and permit inspection of all health and sanitary arrangements at all times by the Employer, Engineer and the staff of the local municipality or other authorities concerned.

(5) The Contractor shall at his own cost, provide first aid and medical facilities at the labour camp and at work sites on the advice of the medical authority in relation to the strength of the Contractor’s staff and workmen, employed directly or through sub-contractors.

(6) The Contractor shall at his own cost, provide the following minimum requirements for fire precautions:

a) Portable Fire Extinguishers.

b) Making and marking exit plan at locations for exit during fires.

(7) The Contractor at his own cost shall provide necessary arrangements for keeping the camp area sufficiently illuminated to avoid accidents to the workers.

(8) The Contractor shall ensure that electrical works are executed by trained electricians and these installations shall be maintained and daily maintenance records be made available for inspection of the Engineer.

(9) Periodic health check- ups may be conducted. These activities may be provided by the Contractor in consultation with State Public Health Department.

(10) It should be ensured by the Contractor that the camp area is cleared of the debris and other wastes and upon completion of construction, the land should be restored back to its original form.

11.2.3 Camp Discipline

(1) The Contractor shall take requisite precautions, and use his best endeavors to prevent any riotous or unlawful behavior by or amongst his workmen, and others, employed directly or through sub-contractors.

(2) These precautions shall be for the preservation of peace and protection of the inhabitants and to secure property in the neighborhood of the Works.

(3) The sale of alcoholic drinks or other intoxicating drugs or beverages upon the work, in any labour camp, or in any of the buildings, encampments or tenements owned or occupied by, or within the control of, the Contractor or any of his employees directly or through sub-contractors employed on the work, shall be forbidden, and the Contractor shall exercise his influence and authority to secure strict compliance with this condition.

(4) The Contractor shall also ensure that no labour or employees are permitted to work at the Site in an intoxicated state or under the influence of drugs.

(5) The Contractor shall remove from his camp such labour and their families, who refuse protective inoculation and vaccination when called upon to do so by the Engineer on the advice of the medical authority.

(6) Should cholera, plague or any other infectious disease break out, the Contractor shall at his own cost burn the huts, bedding, clothes and other belongings of or used by the infected parties.

(7) The Contractor shall promptly erect new accommodation on healthy sites as required by the Engineer, within the time specified by the Engineer, failing which the work may be done by the Engineer and the cost recovered from the Contractor.

(8) Identification card/ badges incorporating the name and photograph of the person and the name of the direct employer (Contractor, Sub-Contractor, etc.) shall be provided to all staff.

11.2.4 Labour Accommodation

(1) The Contractor shall provide living accommodation for all staff employed by himself or his sub-contractors that is equal to or exceeds the minimum criteria established in the following sub-sections.

(2) The buildings shall be constructed so as to have a minimum life of not less than the length of the Contract.

(3) The roofs shall be watertight and laid with suitable non-flammable materials permissible for residential use under local regulations and for which the consent of the Engineer has been obtained.

(4) Each unit shall have suitable ventilation with all doors, windows and ventilators provided with security leaves and fasteners and back to back units are to be avoided.

(5) The minimum height of eachunit shall be 2.10m and each shall have a separate cooking place.The Contractor may provide a common cooking place also.

(6) A suitable number of common toilet/bath shall be provided with separate toilets for ladies.

11.2.5 Water Supply

(1) The Contractor shall provide an adequate supply of water in the Camp.

(2) Where piped water supply is available, supply shall be at stand posts and where the supply is from wells or river storage tanks shall be provided.

(3) The Contractor shall also at his expense make arrangements for the provision and laying of water pipe lines from the existing mains wherever available.

11.2.6 Drainage and Sanitation

(1) The Contractor shall provide efficient arrangements for draining away surface water so as to keep the camp neat and tidy.

(2) Surface water shall be drained away from paths and roads and shall not be allowed to accumulate into ditches or ponds where mosquitoes can breed.

(3) The Contractor shall make arrangements for conservancy and sanitation in the labour camps according to the rules and regulations of the local public health and medical authorities.

(4) The Contractor shall provide a sewage system that is adequate for the number of residents in the camp, and which meets the requirements of the municipal authorities.

(5) The Contractor shall provide lavatories and wash places for the use of its personnel and all persons who will be on the Site.

(6) The size and disposition of lavatories and wash places shall accord with the numbers and dispositions of persons entitled to be on the Site, which may necessitate their location on structures and, where necessary there shall be separate facilities for males and females.

(7) The Contractor shall arrange regular disposal of effluent and sludge in a manner that shall be in accordance with local bye-laws/ regulations.

(8) The Contractor shall be responsible for maintaining all lavatories and wash places on the site in a clean and sanitary condition and for ensuring that they do not pose a nuisance or a health threat.

(9) The Contractor shall also take such steps and make such provisions as may be necessary or directed by the Engineer to ensure that vermin, mosquito breeding etc. are at all times controlled.

11.3 Site utilities and access

(1) The Contractor shall be responsible for providing water, electricity, sewerage and drainage facilities for all site accommodation, structures and buildings and all such services that are necessary for satisfactory performance of the Works.

(2) The Contractor shall make all arrangements with and obtain the necessary clearances from the relevant civil and utility authorities for the facilities.

(3) The Contractor shall be responsible for provision of power supply for its works, plants, equipments and the like etc. from State power supply authorities as well as standby generators etc. at this own cost.

(4) The Employer cannot guaranty provision of adequate, continuous power supply however assistance will be given in obtaining the necessary permissions for Site generators and the like.

(5) Access roads and parking areas shall be provided within the Site as required and shall be maintained in a clean, acceptable and stable condition.

(6) For lengths of roadway longer than 100 m and heavy commercial vehicle are to ply, the Contractor shall provide paved surfacing of adequate thickness and quality to the satisfaction the Engineer.

11.4 Assistance to Engineer/Employer

(1) The Contractor shall be solely responsible for all such instruments and apparatus and shall ensure that they are at all times in good repair and adjustment and shall replace items as necessary to meet this requirement.

(2) All equipment other than expendable items shall revert to the Contractor at the end of the Defect Notification Period.

(3) Any operation of the Works that interferes with the checking of works shall be temporarily suspended at the request of the Engineer until the checking is complete.

(4) It may be necessary for chainmen and survey equipment supplied by the Contractor under this Contract to be used occasionally on work outside the Site in connection with the project although not directly associated with construction activities.

(5) The contractor shall make all necessary arrangements to permit this requirement to be implemented.

11.5 Submission of particulars

(1) The following particulars shall be submitted to the Engineer for his consent not more than twenty eight (28) days after the date of commencement of the Works:

a) Drawings showing the formation works and the layout within the Site of the Engineer's accommodation, the Contractor's offices, project signboards, principal access and other major facilities required early in the Contract, together with all service utilities;

b) Drawings showing the layout and the construction details of the Engineer's accommodation; and

c) Drawings showing the details to be included on the project signboards and diversion boards.

(2) Drawings showing location of stores, storage areas, and other major facilities and their access roads/paths shall be submitted to the Engineer for his consent as early as possible but in any case not less than twenty eight (28) days prior to when such facilities are intended to be constructed on the Site.

12.0 SECURITY

(1) The Contractor shall be responsible for the security of the Site for the full time the Site is in its possession, except for the specific case of the Railway Envelope after handover to the Employer.

(2) The Contractor shall maintain all site boundary fences in first class condition, and shall so arrange site boundary fences at all access drainage points of work areas that it’s use of such access points etc., are not restricted by the system or method of achieving the required security measures.

(3) Notices shall be displayed at intervals around the Site to warn the public of the dangers of entering the Site.

(4) During the progress of the Works the Contractor shall maintain such additional security patrols over the areas of the Works as may be necessary to protect its own and its sub-contractor's work and equipment and shall co-ordinate and plan the security of both the work under this Contract and the work of others having access to and across the Site and the Works.

(5) The Contractor shall liaise with the sub-contractors and the contractors responsible for the adjacent and other interfacing contracts and ensure that co-ordinated security procedures are operated, in particular in respect of vehicles permitted to pass through the Site and/or the adjacent sites in the later periods of the Contract.

13.0 PRECAUTIONS WHILE WORKING IN CLOSE PROXIMITY OF EXISTING INDIAN RAILWAY TRACK

13.1 General

(1) Prior to the commencement of construction operations, the Contractor shall obtain all necessary clearance from the concerned authorities.

(2) Any construction activity involving the existing embankment/formation/ running track of the Indian Railways shall be carried out only with the prior specific authorization of the Engineer.

13.2 Works being executed outside running lines are further divided into following 3 sub-groups depending upon their distance from the IR track:-

a) Works being done within 3.5 meters from Centre of track.
b) works being done between 3.5 meters and 6 meters from Centre of track
c) works being done beyond 6 meters from Centre of track

If a work site is located far away from the existing track but the vehicles in connection with the work are required to ply within the distance from center of track as mentioned above, it will be construed that the work in being executed under above classification.

13.2.1 Works being done within 3.5 meters from Centre of track.

(i) All works planned within 3.5 meters from Centre of running line or which involve working of machineries and vehicles within this zone, are to be done essentially under block protection and necessary safety precautions for protection of track as per para 806 and 807 of IRPWM be taken. This includes even occasional plying of vehicles/ machineries for short durations.

13.2.2 Works being done between 3.5 meters and 6 meters from Centre of track.

Following precautions be taken when works are required to be done between 3.5 meters to 6 meters from track center or machines/vehicles are required to work/ply within this zone.

(i) Before start of work demarcation should be done parallel to running track at a distance of 3.5 meters from center of track in advance, as per sketch B, by 150 mm wide white line of lime. Any work or movement of machinery infringing this line will need block protection. Barricading should be put up at such locations, as per sketch C, to ensure that even by carelessness or over sight, vehicles do not infringe fixed dimensions. Barricading design shall be approved by the Engineer.

(ii) In case vehicles have to ply or machineries have to work within this zone, railway's and contractor's supervisors be positioned as shown in sketch D except for the following:

Instead of a Railway supervisor it would be a responsible and trained staff of the Contractor as mentioned in Para 13.1.2.2 (ii) above.

(iii) Additional trained staff of the Contractor, as mentioned in para 13.1.2.2 (ii) above, shall be posted where turning of vehicles is required during working. Location for reversing vehicles should be nominated and it should be selected in such a way that there is no danger to running trains at such a location. Such

trained staff of the Contractor should be available with hand flags so that vehicles do not come closer to track by 3.5 meters. Wherever vehicles have to take turn, it should be done in such a way that the driver is invariably facing the running track at all times.

(iv) Look out men should be posted along the track at a distance of 800 meters from location of work with red flag and to whistle in face of road vehicles and approaching trains. Look out men shall also be suitably trained staff of Contractor as mentioned in Para 13.1.2.2 (ii) above.

(v) In addition to look out men, caution order needs to be issued to trains and speed restrictions imposed wherever considered necessary through Employer.

(vi) Arrangements should be made to protect the track in case of emergency at work site.

(vii) All temporary arrangements required during execution should be done in a manner that moving dimension is not fringed.

(viii) Individual vehicle/machinery shall not be left unattended at site of work. If it is unavoidable and essential to stable it near running track, it shall be properly secured and manned even during non-working hours with all arrangements to protect the track from infringement.

(ix) Any materials unloaded or shifted along the track should be kept clear of moving dimensions and stacked at a specified distance from running track.

(x) Movement of vehicle/working of machineries should be prohibited at night. However, in case of emergency when night working is unavoidable, adequate lighting shall be provided with all protection measures as mentioned above in full force. All night working near IR track shall require Engineer's prior approval.

(xi) The work site should be suitably demarcated to keep public and passengers away. Necessary signages, boards, such as "work in progress" etc. should be provided at appropriate location to warn public/passengers.

(xii) Contractor's drivers/operators handling vehicles/machineries shall be issued a fitness certificate by the safety officer of the Contractor after educating them about safety norms and after taking assurance in writing for working within vicinity of railway's track.

(xiii) While working on cuttings with machineries or when there is movement of vehicles above cutting, if there is possibility of any of the following circumstances, work has to be done under block protection:

a) Any possibility exists for machinery/vehicle after toppling/due to loss of control come over track or infringe it.

b) Chance of machineries/vehicles to come within 3.5 meters from track Centre though working beyond it.

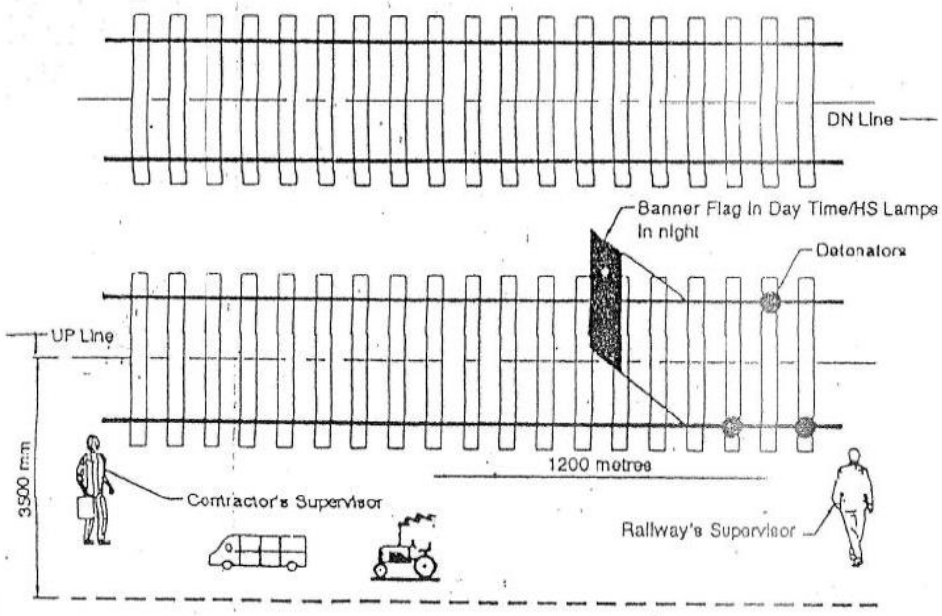
13.2.3 Works being done beyond 6 meters from Centre of IR track.

No precautions are needed except in cuttings or where the work can affect train running in any way.

SAFTY/PROTECTION ARRANGEMENT SKETCHES

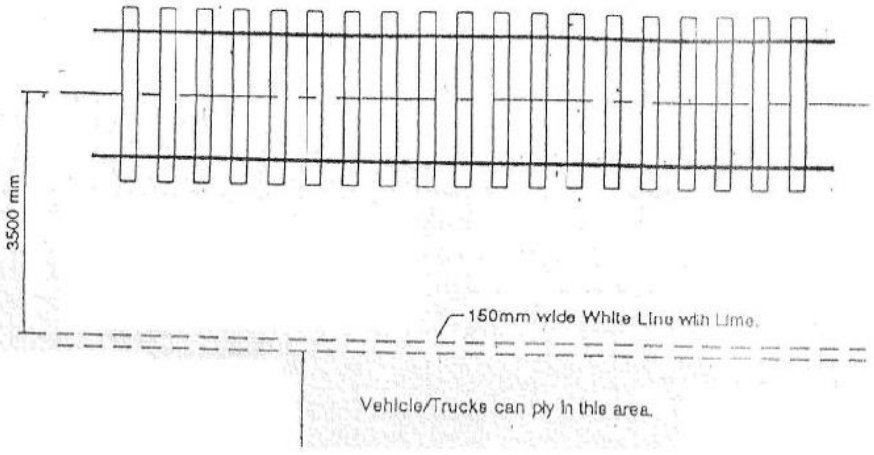
SKETCH - A

Plying of Vehicles/Machinery within 3.5 Mts. from centre of track.



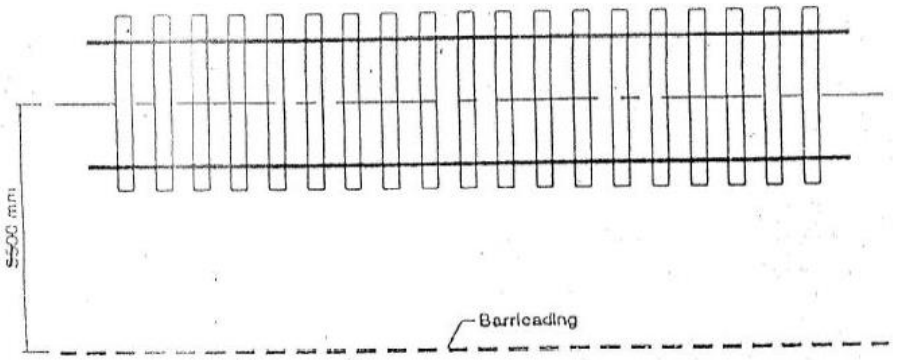
SKETCH - B

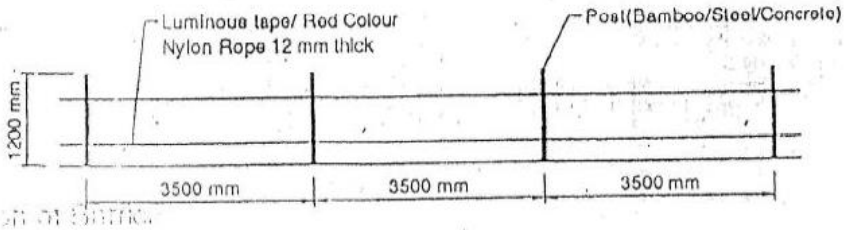
Marking of White Line with Lime.



SKETCH - C

Provision of Barricading.

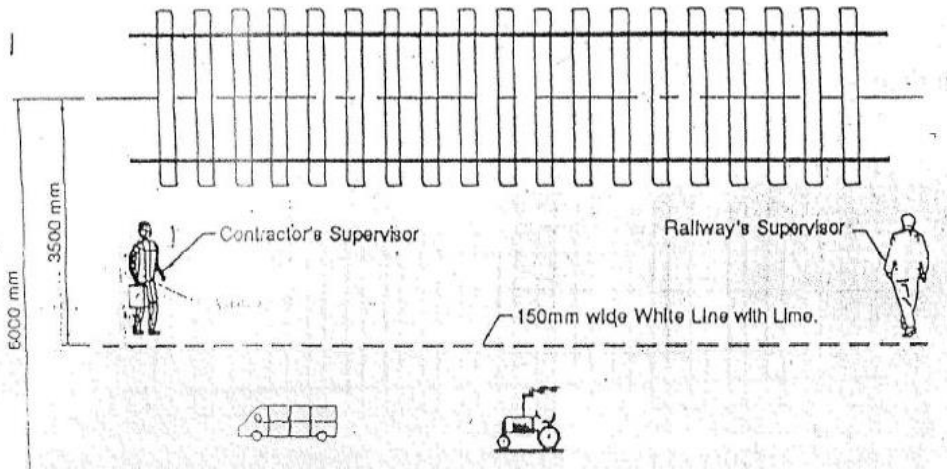




Elevation of Barricading

SKETCH - D

Plying of Vehicles/Machinery between 3.5 Mts. to 6.0 Mts. from centre of track.



14.0 CONSTRUCTIONS-S&T WORKS

14.1 General

(1) The Contractor shall co-ordinate during the planning and execution of works with designated Contractors for other related activities e.g. track, Civil, Electrical work etc. for construction of the complete system of Dedicated Freight Corridor.

(2) The installation of all machinery and equipment shall be undertaken at all times by suitably trained and competent employees of the Contractor and to the satisfaction of the Engineer.

(3) The Contractor shall, prior to starting any installation and construction work, identify any possible hazards, and implement measures of eliminating and/or controlling such potential hazards, in line with safe working practices.

(4) The Contractor shall require access to information as well as to various locations at stations/depots/tracks/bridges etc. of Indian Railways in stages.

a) A written request regarding access to any information shall be given by the Contractor to the engineer sufficiently in advance for arranging the same as available.
b) The Contractor shall plan out in consultation with other designated contractors the number and location of the access points and shall submit the same to the Engineer at least two months in advance

(5) The construction and installation work pertaining to this contract shall include, but not be limited to the following:

a) Survey on site, review and confirm the technical requirements shown in this contract and the Reference Drawings.
b) Finalization of the manufacturing/construction and installation program.
c) Production of the calculation sheets and manufacturing/construction drawings/specifications for Site works and installation.
d) Construction and Installation in accordance with the finalized construction Drawings.
e) Co-ordination with various designated contractors.
f) Obtaining clearances from various stakeholders and authorities.
g) Submission of the manufacturing/construction and installation reports and records.
h) Testing and commissioning as per finalized protocol and programme.
i) Production of As Built Drawings, documents, calculation sheets and records.

14.2 Temporary Works

(1) Any temporary arrangements and works, as required to carry out the S&T work such as temporary depots to handle and stack the materials, temporary stores, offices, fencings etc. shall be done by the Contractor at his own cost.

(2) The programme and scheme and design of all such temporary works with full justification of the requirement and the approximate period for which these will be needed, shall be submitted to the Engineer for prior approval.

(3) Construction Depot

a) The Contractor will be required to establish at least one temporary construction depot at the site of works where materials and equipments etc. could be stored for the construction purposes. The location of temporary construction depot shall be got approved by the Engineer.

b) In case spare land is available with the Employer the same can be handed over to the Contractor free of cost for the purpose of establishing temporary construction depot(s). However, whenever Employer requires this portion of

land back, the same shall be handed over to the Employer with a month's notice at no extra cost/compensation to the Contractor.

(4) All temporary works shall be removed on completion of permanent works, or as directed by the Engineer.

15.0 MANUFACTURE, SUPPLY, INSTALLATION, TESTING & COMMISSIONING

15.1General

(1) These Employer's 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 in the Permanent works.

(2) These requirements relate to manufacturing, procurement and delivery of component fittings, conductors, equipment structures, plant and manufactured items and the requirements for installation, testing and commissioning, and associated activities (manuals, spares, training etc.).

(3) The Contractor shall submit a comprehensive Test Plan &Programme for the project to the Engineer for his consent.

(4) The Contractor shall inform the Engineer of the installation of the manufactured items including manufacturing plan and schedule of the manufactured items at the manufacturer's facilities.

(5) The Engineer or Employer's representative shall be offered to participate for the tests particularly the Type Tests to be performed on the equipment and/or fittings or conductors and/or batches materials to be examined before the material is supplied to the Site.

(6) The Contractor shall organize those participations as required by the Engineer.

(7) The materials delivered/supplied by the contractor to the Site and offered for Inspection shall be manufactured normally not earlier than one (1) year and their guarantee period shall cover the Defects Notification Period. However the specified period of Manufacturer's Warranty shall commence from the date of commissioning of the Work and all the manufacturer's Warranties shall be in the name of Employer.

(8) All materials shall be as per the Specifications furnished and as consented by the Engineer.

(9) Manufacturing and testing of various components, fittings, clamps, jumpers, droppers, other fittings, components and equipment shall be as per relevant RDSO and other Specifications, as accepted by the Employer.

(10) The Contractor's Manufacturing Management and Quality Assurance Plans shall be submitted to the Engineer for consent within 60 days after the Commencement Date as a preliminary plan and as part of the Technical Design for the final Plans for each plant, equipment and manufactured item

15.2 Procurement and subcontract management

(1) The Contractor shall prepare and implement a Quality Assurance plan based on ISO 9001 standards addressing each element therein for the management systems and procedures for materials procurement and sub-contracting, sufficient to assure technical, administrative, quality and contractual controls consistent with those of this contract.

(2) The Contractor's management system shall be auditable for material sources, lot numbers, serialiased equipment, etc., sub-contract amendments shall be employed

whenever contractual changes are made either bi-laterally or unilaterally by the parties involved.

(3) Registration of the Contractor's organization, or subcontractors or sub-consultants is not required for this Project but the Project Quality Management Plan, as submitted, shall meet the intent of the ISO 9001 requirement in that there is a comprehensive and documented approach to achieving the project quality requirements.

15.3 Manufacturing and production management

(1) The Contractor's manufacturing and production management system shall encompass all aspects of receiving, raw material and components processing, fabrication, assembly, test and all points of in-process inspections. The Contractor shall submit manufacturing data as part of the Manufacturing Management Plan, and this shall contain:

a) Brief description of all inspection hold points and test points, and a correlation with the Programme Schedule;
b) List of all sub-contractors; and
c) Shipping and delivery schedule of each item of equipment to match the installation plan.

15.4 Testing

(1) The Contractor shall provide a comprehensive testing programme that shall include the complete equipment, their subsystems, components and material to assure conformance with the Specifications.

(2) The testing programme shall be approved by the Engineer.

(3) The purpose of the comprehensive testing programme shall be to:

a) substantiate design where specified under the Contract and performance characteristics;
b) ensure operational compatibility;
c) complete equipment verification and acceptance requirements; and

(4) Testing shall comply with the requirements contained in Employer's Requirements.

15.5 Inspection by the Engineer and Employer's representative

(1) The Contractor shall prepare an Inspection Programme for agreement by the Engineer which shall provide the opportunity for the Engineer and/or the Employer's representative to have access at key points during the production and manufacture of Materials and Plant to examine, inspect, measure, and test the materials and workmanship, and check progress, as necessary.

(2) Where such an inspection takes place on completion of production or manufacture this may be combined with the Testing Programme.

15.6 Quality assurance and controls

(1) The Contractor shall be responsible for quality control including all testing, checking and measurement.
(2) The Employer or the Engineer may carryout independent quality control tests through his own personnel or other agencies.
(3) The Contractor shall provide all necessary assistance and cooperation to the Employer and the Engineer for carrying out the inspections and tests.
(4) The Contractor's management systems shall emphasize quality assurance and controls and shall be based on ISO 9001 standards.
(5) The programme shall ensure an acceptable level of quality for the equipment supplied.

(6) The concept of total quality assurance shall be based on the principle that quality is a basic responsibility of the Contractor's organization, and shall be evidenced by:

a) Producible and inspectable designs;
b) Procurement and job performance specifications;
c) Procedures for transmission of information and data to sub-contractors and for ensuring their compliance;
d) Testing to ensure repetitive product conformity to design requirements; and
e) Total programme of surveillance and verification of physical performance and configuration accountability.

(7) Adequate records shall be kept by the Contractor to provide evidence of quality and accountability, these records shall include results of inspections, tests, process controls, certification of processes and personnel, discrepant material; and other quality control requirements.

(8) Inspecting and testing records shall be in ISO format and, as a minimum indicate the nature of the observations made, and the number and types of deficiencies found and action proposed to correct deficiencies.

(9) Records for monitoring work performance and for inspecting and testing shall indicate the correction of deficiencies.

(10) The Contractor shall submit to the Engineer a request for a "Notice of No Objection to Supply" for all manufactured items along with all the relevant manufacturer's test certificates and inspection certificates prior to shipping/transporting. This shall be accompanied by a Verification Submission which shall provide sufficient documentary demonstration of the suitability of the Plant & Equipment and manufactured items for supply.

(11) Such Notice may be issued by the Engineer in respect of the completion of Manufacturing of a major and distinctive element comprising part of the Permanent Works.

(12) However, supply shall not be commenced until the original copies of the appropriate Submission have been endorsed:

a) by the Contractor as "Good for Supply";
b) by the Engineer that he has no objections to the supply.

(13) In addition, the Contractor shall comply with **Part 2, "Employer's Requirements, Section V(A) and V(B)**and the "Quality Management" requirements stated elsewhere in this Volume.

(14) The inspection is to be conducted by the contractor and witnessed by the Engineer and/or the Employer's representative. The Employer may depute its representative or nominate any other independent inspection agency such as RDSO/RITES, (in addition or as replacement) for supervising, monitoring and inspection of raw/final material and manufacturing process at the factory.

16.0 MATERIALS AND EQUIPMENT

(1) Materials and goods for inclusion in the Permanent Works shall be new. Certificates of tests by manufacturers which are to be submitted to the Engineer shall be current and shall relate to the batch of material delivered to the Site.

(2) Certified true copies of certificates may be submitted if the original certificates could not be obtained from the manufacturer. A letter from the supplier stating that the certificates relate to the material delivered to the Site shall be submitted with the certificates.

(3) Parts of materials which are to be assembled on the Site shall be marked to identify the different parts.

(4) In addition to any special provisions in the Contract for the sampling and testing of materials, the Contractor shall submit samples of all materials and goods which it proposes to use or employ in or for the Works. Such samples, if having been reviewed without objection, shall be retained by the Engineer and shall not be returned to the Contractor or used in the Permanent Works unless reviewed by the Engineer. No materials or goods of which samples have been submitted shall be used in the Works unless and until the Engineer shall have reviewed such samples without objection.

(5) The samples shall be used as a mean of comparison which the Engineer shall use to determine the quality of the materials subsequently delivered. Materials delivered to the Site for use in the Permanent Works shall be of the same or better quality as the samples which have received consent.

(6) The Employer's Representative may reject any materials or goods which in his opinion are inferior to the samples. Given a Notice, the Contractor shall promptly remove such materials and goods from the Site.

(7) **Notice of place of manufacture and/or source of supply**

The Contractor shall notify the Engineer of the places of manufacture and/or the source of supply of all goods and materials to be incorporated into the Permanent Works. The Contractor shall give reasonable notice (which shall not in any event be less than 28 days) to the Engineer before the start of any manufacturing and/or the supply of goods and materials.

(8) **Certificates for Manufactured Goods or Materials**

The Contractor shall obtain certificates for each batch of goods and materials in corporate into the Permanent Works. Each certificate shall certify that the materials comply with the requirements of the Contract and shall include all reports of inspections and/or tests carried out at the place of manufacture.

17.0 MANUFACTURE & SUPPLY VERIFICATION SUBMISSION

(1) On completion of the manufacture of Plant, the production of Materials, and the associated testing, and Quality Assurance and Control processes, a 'Manufacture & Supply' Verification Submission shall be prepared which shall provide sufficient documentary demonstration of the suitability of the Plant and Materials for subsequent installation, this shall include, but not be limited to:

a) confirmation that the manufactured items of Plant or Materials produced fully comply with the Drawings/Specifications relating to manufacture;

b) confirmation that all relevant testing has been successfully completed, with supporting completed test documentation;

c) confirmation that all Quality Assurance and Controls processes have been completed with the required level of satisfaction, with supporting completed Quality Assurance documentation;

d) Confirmation that the Plant and/or Materials have not suffered damage or deterioration during transit to site.

(2) The Contractor shall not commence the subsequent Installation phase until he has received a Notice of no Objection from the Engineer in respect of the Manufacture & Supply Verification Submission.

18.0 INSTALLATION

18.1 Installation Plan and Programme

(1) The Installation Plan shall show how the Contractor proposes to organize and carry out the Installation and complete the whole of the Works by the given Key Dates.

(2) The Contractor shall submit the Plan for the review of the Engineer 30 days prior to the start of Installation on Site.

18.2 Installation Method Statement

(1) Installation Method Statements shall be submitted to the Engineer for review at least 28 days prior to the installation activity commencing On-Site, this shall show in particular the loadings and modes and delivery routes of the items of equipment.

(2) Prior to proceeding with installation, the Contractor shall submit for the Engineer's consent five 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.

(3) The manufacturer's rigging or erection instructions shall be carefully followed.

(4) The Contractor shall ensure that the installation of all supports, gaskets, hardware, etc., is accomplished so as to assure safe, accurate and trouble-free installation. The Installation for major items shall be undertaken preferably in the presence of the Manufacture's Field Service Representative.

(5) Upon noticing or being advised of any inconsistencies between the maintenance drawings and documentation and the installed equipment, the Contractor shall notify his acknowledgement to the Employer and correct such errors within two weeks.

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

(7) Contractor shall submit the Installation Testing Plan (ITP) for major items for approval by Engineer and installation and testing shall be carried out according to approved ITP.

18.3 Asset Identification

(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.

(2) The database shall provide the minimum information as follows:

a) asset details;
b) failure history;
c) date installed; and
d) date(s) tested.

(3) All equipment and software shall have a unique identification number that can be identified electronically and manually.

(4) The identification label shall be permanently attached in such a way that it shall not become detached or illegible during the lifetime of the system from any cause including wear and tear, environmental effects (such as rain, direct sunlight, etc.) or any other influence. Preference shall be given to emboss or engraved metallic labels mechanically fastened by riveting or similar means to the item to which they refer.The Identification shall be placed so as to be easily read for the accessible face.

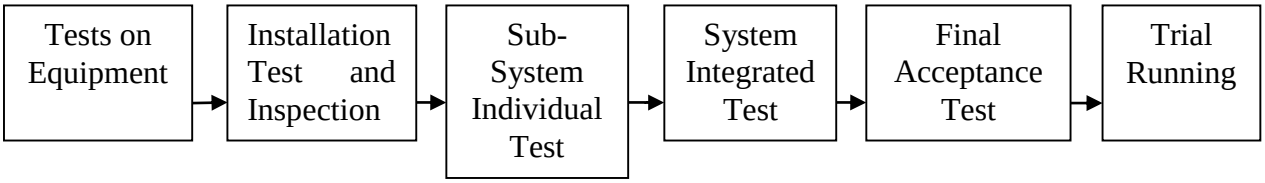
19.0 TESTING AND COMMISSIONING

19.1 General

(1) The Contractor shall provide and perform all forms of testing procedures applicable to the Works and various components including all necessary factory, site and acceptance tests required therein and for the interfacing of the Works with the other Contract works. Until the time the Works are taken over by the Employer, Contractor shall maintain the same in a manner so as to continuously meet the acceptance criteria for all aspects, as per the requirements mentioned in the **Employer's Requirement, Part 2 of Bid Document.**

(2) Contractor shall make a consolidated list of all the tests required for Testing and commissioning along with the method statement detailing testing procedures and applicable codes/ manuals and submit the same to the Engineer for enabling a joint program of testing. 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.

(3) The commissioning activity shall include a period of Integrated Testing of System followed by a period of trial running attended by the CRS or other authorized official and for staff training and familiarization and timetable proving purposes. Accordingly a typical test sequence may be as shown below:-



(4) The Engineer, the Employer's Personnel and authorized agencies 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.

(c) The Contractor shall give them 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. They shall be provided the facilities for monitoring all tests and have access to all testing records.

(5) Ample time shall be allowed within the testing programme for necessary alterations to equipment, systems and designs to be undertaken, together with re-testing prior to final commissioning.

(6) The testing procedures shall be submitted by the Contractor and amended, if required subsequently 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.

(7) All costs associated with the Testing shall be borne by the Contractor. However this shall not include allowances for hotel and expenses for the person witnessing/certifying the test on behalf of the Engineer/Employer representative. The Contractor shall also bear any expenses incurred due to resetting/re-testing caused by defects or failure of equipment to meet the requirements of the Contract in the first instance.

(8) The contractor shall bear all expenses including hotel/travel/cost of witnessing if any incurred due to retesting caused by defects or failure of equipment to meet the requirements of the contract in the first instance.

(9) In the event of any tests being performed in countries other than India, the Contractor shall give at least 60 days' notice to the Engineer / Employer for witnessing the tests.

(10) Unless agreed 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.

(11) The Employer and the Engineer will bear their own cost for attendance at witnessed inspections or tests (other than re-test) scheduled in accordance with agreed Test plan and subject to notice in accordance to the specification. Further details are given in Particular specification.

(12) All testing equipment shall carry an appropriate and valid calibration labels

(13) Examination of Works before covering up: No work or part of work shall be covered up or put out of view, without the prior approval of the Engineer or the Engineer's Representative. The Contractor shall uncover any part or parts of the Works, or make openings in or through the same, as the Engineer may from time to time direct, and shall reinstate and make good such part or parts, to the satisfaction of the Engineer.

(14) If any defect or damage requires immediate attention from a safety, environment or operational aspect, the Engineer has the authority to proceed with the rectification in any manner suitable and deduct the cost from the next due interim payment.

(15) Testing shall be undertaken generally in accordance with the requirements contained within relevant clauses of the latest version of standards relating to the particular equipment concerned, together with other relevant standards which relate specifically to testing.

(16) Inspection and Testing Philosophy.

(a) The inspection of various items shall be carried out by the agencies in the manner as approved by the Engineer.

(b) All field tests shall be witnessed by authorized representative of the Engineer / Employer & recorded. An appropriate format for Test Schedules and Procedures including the details of testing equipment shall be submitted to the Engineer for approval. All tools & instruments for carrying out the tests shall be arranged by the Contractor to the satisfaction of the Engineer. Test results will be witnessed and signed by the Contractor and the Engineer.

(c) Test Certificates and Reports: The Contractor shall submit manufacturer's type and routine test certificates and reports for each equipment and devices. Complete test results are to be submitted in clearly identified and organized booklets, 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.

19.2 Manufacturing Test Plan

19.2.1 The Manufacturing Test Plan is the Contractor's plan for carrying out the necessary procedures to ensure that the items presented for acceptance by the Employer and Engineer are in compliance with the requirements of the Specification.

19.2.2 During the process of procurement and manufacture of the system components the Contractor shall undertake such testing and inspection as is required by the Quality Plan.

19.2.3 The Employer's Personnel will not become involved in the Contractor's Manufacturing Tests except in respect of :

- Type tests ;and
- Factory Acceptance Test

19.2.4 Before shipment of any items to Site the Contractor shall present the items for the first stage of Acceptance according to the Commissioning Plan.

19.2.5 The Contractor shall be wholly responsible for all the inspection of items to be incorporated into the system as a whole.

19.2.6**Type Tests**

(1) Type tests will not be required in those cases where the Contractor can produce certified evidence within last 5years, that the required type tests have been performed successfully on identical equipment or equipment which is, for practical test purposes, of identical design, made using identical raw materials/components, made using identical software version under similar manufacturing conditions in the factory where the equipment offered is to be manufactured, provided the type test(s) have been carried out and /witnessed by reputed agencies. The final decision regarding applicability and acceptance of the type test certificate produced shall rest with Engineer.

(2)For each test, the Engineer will determine whether the item under test has passed or failed. In general, the test will be considered to have failed if either:

- The result of the test is not in accordance with the expected result described in the test procedure, or
- The result of the test is in accordance with the expected result described in the test procedure, but some other unexpected or unexplained event occurred which the engineer considers to be a fault.

(3) If during Type Tests, any failure occurs or the equipment design is changed, it shall be reported to the Engineer who may, at his discretion, require repetition of the previous tests at the Contractor's cost.

19.2.7**Factory Acceptance Test(FAT)**

(1) Before shipment all manufactured items or systems shall undergo FAT in accordance with the requirements of the PS.

(2) Factory Acceptance Test (FAT) or works test

(a) Works Tests shall include but not be limited to:

- Physical inspection;
- Dimensional test
- Calibration;

- Output check;
- Operational performance;
- Full Load test;
- Flash-over test;
- Insulation test;
- Soak test; and
- Any other test required as per relevant standards or codes.

(b) A Factory Test Plan shall be submitted for the Engineer's review within three months from the Date for Commencement of the Works.

(c) All materials, components, sub-assemblies, unit assemblies (including software, cables and wiring) shall be subject to testing and certification. Notification of these Tests shall be submitted to the Engineer thirty (30) days in advance of carrying out any Test, the Engineer will then determine which, if any, items that may be accepted based on previous supply or experience.

(d) At least 15 days prior to each FAT the latest drawings, inspection and test procedures, specifications and quality documentation required for adequate inspection of the equipment under inspection shall be submitted to the Engineer. The drawings shall be completed to the lowest level replaceable unit.

(e) The Contractor shall ensure that he and his subcontractors are prepared for all inspections/test. The Contractor shall not schedule more than one FAT on the same day without prior notice of No Objection by the Engineer.

(f) The FAT shall demonstrate that each equipment/sub-system meet its functional specification.

(g) 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 specification by carrying out the FAT.

(h) Where processor based equipment is to be used, the Works Tests shall include also verification of software used in this application.

(i) FAT shall be performed by the contractor and the Engineer/ the Employer shall attend FAT on all major equipment items or sub-systems identified by the Engineer. The Employer may authorize other agency like RDSO, RITES for FAT for inspection on behalf of the Employer.

19.3 **Commissioning Plan**

(1) The Commissioning Plan is the Employer and the Engineer tool for managing and co-coordinating the Testing, Commissioning, Training and Service Trial activities. The Commissioning Plan will be divided into the following sub-plans:

(i) Factory Testing Plan
(ii) On-Site Testing and Commissioning Plan

(2) Testing and Commissioning Phases

Testing and Commissioning activities shall be undertaken in the following phases:
(i) Factory Acceptance Test
(ii) Installation Tests;
(iii) Partial Acceptance Tests;

(iv) System Acceptance Tests;

(v) Integrated Testing & Commissioning; and

(vi) Service Trial.

Note: Items (iii), (iv), (v) and (vi) as required by the PS constitute the Tests on Completion referred to in the GCC.

19.4 On-Site Testing and Commissioning Plan

19.4.1 The Contractor shall prepare and submit for a Notice by the Engineer the Contractor's On-Site Testing and Commissioning Plan detailing and explaining how the Contractor will plan, perform and document all tests and inspections that will be conducted to verify and validate the Works on Site. The On-Site Testing and Commissioning Plan shall consist of a narrative description supported by graphics, diagrams and tabulations as required.

19.4.2 The On-Site Testing and Commissioning Plan shall contain, but not be limited to, the following topics:

(i) The Contractor's strategy for testing and commissioning all constituent parts of the Works and how this relates to the sequence of construction and installation;

(ii) The interdependency and interaction with other Contractors and their commissioning programme;

(iii) The type and extent of testing and commissioning to be undertaken and the parts of the Works to be proven by that testing;

(iv) The objective of each test, what particular design and operating criteria the test or inspection will prove and how the success of the test will be demonstrated or measured;

(v) The plan for the production and submission of the testing and commissioning procedures to the Employer's Representative for review including the submission of the testing and commissioning reports and records; and

(vi) The On-Site Testing and Commissioning Plan shall be organized and submitted in the stages

19.4.3 Installation Tests

a) The Installation Tests is defined as being the final stage of assembly/installation before the start of commissioning itself. The Installation Tests are to be performed by the Contractor under the Contract and may be witnessed by the Employer or the Engineer. During this phase, the Contractor shall perform static testing of components and/or systems in preparation for Partial Acceptance Testing.

b) The particular requirements for Installation Tests are prescribed in the PS. Where performance across interfaces to other Contractors or to other parties is required to be verified, the Contractor shall liaise with the interfacing party to co-ordinate the test procedures and programme.

c) The Contractor shall submit to the Engineer an Installation Test Plan including a comprehensive schedule of tests as required by the Particular Specification giving full details and procedures for each test to be carried out under the Contract and including the pass / fail criteria i.e. the standards or limits to be achieved.

d) Prerequisites for Installation:

i. Prior to installation, the Contractor shall ensure that equipment delivered to Site has not been damaged in transit and ensure for their dimensional accuracy.

ii. Designs for the Sections under test shall be completed and submitted to the Engineer for review prior to Installation.

e) The Contractor shall prepare three copies of a test report immediately after the completion of each test whether or not witnessed by the Employer and/or the Engineer. If the Employer and /or the Engineer has witnessed the test, he will countersign the report to indicate his Notice of No Objection to the information and conclusions (i.e. whether or not the equipment being tested has passed satisfactorily) contained therein. If the Employer and/or the Engineer has not witnessed the test (i.e. if a written waiver has been granted),the Contractor shall forward three copies of the test report without delay to the Engineer.

f) The Engineer will countersign the report to indicate his Notice to the information and conclusions (i.e. whether or not the equipment being tested has passed or failed) and return one copy to the Contractor. Where the result of the test do not meet the requirements of the Specification, the Employer or the Engineer may call for a re-test at the Contractor's own expenses.

g) Test equipment and instrumentation shall be subject to calibration testing within a properly controlled calibration scheme, and signed calibration certificates shall be supplied to the Engineer in duplicate. Such calibration checks shall be undertaken prior to testing and, if required by the Employer or the Engineer, shall be repeated afterwards.

19.4.4 Partial Acceptance Tests (PAT)

(1) Partial Acceptance Tests are defined as the performance of functional tests of sections, areas, or stages of a system. The Partial Acceptance Tests are part of the Tests and Inspection to be performed by the Contract or under the Contract in order to achieve the Employers Taking Over of the Works. During this phase, an energy source shall be introduced to enable functional testing to be performed. On satisfactory completion of the Partial Acceptance Tests, the tested items will be considered available for Systems Acceptance Testing.

(2) The particular requirements for Partial Acceptance Tests are prescribed in the PS.

(3) The Contractor shall submit to the Engineer a comprehensive Partial Acceptance Tests Plan including all requirements detailed in the PS. The plan shall be submitted on a logical section-by-section basis, using a "top-down" approach describing the testing and commissioning strategies and processes clearly showing how these serve to provide the full verification of the systems and equipment.

(4) The Partial Acceptance Tests Plan shall identify a comprehensive list of specifications, standards, method statements, procedures, pass/fail criteria, sample records, resources to be made available, drawings and records to be submitted to the Engineer, and a programme showing the dates for testing and for submission of each test procedure.

(5) Test procedures shall be carefully planned to ensure that the work can be executed in the time available. If the available time is restricted, this planning shall include contingency plans to be implemented if testing proceeds slower

than anticipated or if defects are discovered that necessitate rectification and subsequent repeat testing, etc.

(6) If any working equipment is relocated or altered by the Contractor during the execution of the Works, thorough re-testing shall be performed to verify that the equipment remains fully functional and operates safely according to its specification. The testing to be performed shall be no less rigorous than the procedures used for the original testing and commissioning of the equipment.

(7) The Contractor shall submit to the Engineer by the date laid down in the Particular Specification, or if no date is given, no later than two months before the commencement of the Testing & commissioning work, three copies of its proposed Partial Acceptance Tests sample records. The records shall be appropriately sub-divided to make provision for the various parts of the systems and equipment covered by the Contract and shall cover all tests (mechanical, electrical or otherwise), positive identification of equipment, assemblies and sub-assemblies by serial number, drawing and specification reference numbers (and issue reference) and any other data to be given Notice by the Engineer during the course of commissioning.

(8) The Contractor shall during the execution of the Works prepare such reports and records of design, manufacture, installation, erection and testing as may be required in order that any relevant licenses or approvals (including any statutory approvals) may be issued or granted. Such records shall be adequate to enable the system or its respective part to be commissioned and to meet the requirements of the licensing authority or statutory body.

(9) Immediately following the successful Partial Acceptance Testing of the system or any constituent part, the Contract or shall complete the appropriate Partial Acceptance Tests records in the agreed format and submit three signed copies to the Engineer.

19.4.5 System Acceptance Tests (SAT)

(1) System Acceptance Tests are defined as the tests undertaken to demonstrate that the Works in its entirety is capable of functioning in accordance with the specified requirements in the Contract in all respects. The System Acceptance Tests are part of the Tests on Completion to be performed by the Contractor under the Contract in order to achieve Employer's Taking Over of the Works. The System Acceptance Tests may commence before remote operations capability (if any) is fully functional, however, the system must be satisfactorily tested remotely (if specified to have such capability) before the System Acceptance Tests can be considered to be completed. On satisfactory completion of the System Acceptance Tests, the tested items will be considered available for Integrated Testing & Commissioning.

(2) The particular requirements for System Acceptance Tests are prescribed in the PS.

(3) The Contractor shall submit to the Engineer a comprehensive System Acceptance Tests Plan including all requirements detailed in the PS. The plan shall be submitted on a section by section basis to demonstrate how the System Acceptance Tests are to be carried out. The plan shall adopt a top down approach and describe the system completion strategy and process.

(4) System Acceptance Tests shall comprise comprehensive testing of the assembled installation to ensure that it operates in accordance with the requirements of the PS.

(5) Prerequisites and requirements for SAT to be satisfied before the commencement of the System Acceptance Tests (SAT) shall be as follows:

i. All documentation for the System Safety Report shall be submitted to the Engineer for review;

ii. All PAT shall be completed and test records submitted to the Engineer for review;

iii. Employer's Personnel shall be given a training course in the System as defined in the Section on Training herein;

iv. The SAT Plan shall be submitted to the Engineer for review at least one hundred and twenty (120) days before the commencement of the SAT.

(6) The tests shall include but not be limited to, the following:

a. Tests of all functional and performance requirements for the system;

b. Tests of behavior under failure conditions, e.g. functioning of failsafe mechanisms, changeover to redundant hardware; initiation of re-configuration functions or reverse modes of operation; and recovery of the equipment and system from failure.

(7) The System Acceptance Test Plan shall identify a comprehensive list of specifications, standards, method statements, procedures, pass / fail criteria, sample records, resources to be made available, drawings and records to be submitted to the Engineer for a Notice and programme showing the dates for testing and for submission of each test procedure.

(8) Test procedures shall be carefully planned to ensure that the work can be executed in the time available. If the available time is restricted, this planning shall include contingency plans to be implemented if testing proceeds slower than anticipated or if defects are discovered that necessitate rectification and subsequent repeat testing, etc.

(9) Immediately following the successful acceptance testing of the system, the Contractor shall complete the appropriate Testing & commissioning records in the agreed format and submit three signed copies to the Engineer.

19.4.6 Integrated Testing & Commissioning

(1) Integrated Testing & Commissioning are defined as the final tests to be undertaken before the commencement of Service Trial. The Integrated Testing & Commissioning are part of the Tests on Completion to be performed by the Contractor under the Contract in order to achieve Employer's Taking Over of the Works. The Integrated Testing & Commissioning shall demonstrate the full compatibility between all interfacing systems. On satisfactory completion of the Integrated Testing & Commissioning, the tested items will be considered available for Service Trial.

(2) The particular requirements for Integrated Testing & Commissioning are prescribed in PS

(3) The Contractor shall submit to the Engineer a comprehensive Integrated Testing & Commissioning Plan as required by the PS. The plan shall be submitted on a logical section-by-section basis, using a "top-down" approach describing the testing and commissioning strategies and processes clearly showing how these serve to provide the full verification of the systems and equipment in context of the complete railway system.

(4) The Contractor shall co-ordinate with the Employer and the Engineer and with all interfacing parties to ensure that the proposed test programme and schedule truly demonstrate that the full specified performance requirements are achieved.

(5) The tests shall include, but shall not be limited to the following:-

a) test of all functional and performance requirements for the system;

b) test to demonstrate compliance with all interface specifications; and

c) test of behaviour under failure conditions (e.g. changeover to redundant hardware, initiation of re-configuration functions or reversionary modes of operation, recovery of systems and equipment from failure, demonstrations of planned emergency procedures, etc.).

(6) The Integrated Testing & Commissioning Plan shall identify a comprehensive list of specifications, standards, method statements, procedures, pass/fail criteria, sample records, resources to be made available, drawings and records to be submitted to the Employer's Representative, and a programme showing the dates for testing and for submission of each test procedure.

(7) Test procedures shall be carefully planned to ensure that the work can be executed in the time available. If the available time is restricted, this planning shall include contingency plans to be implemented if testing proceeds slower than anticipated or if defects are discovered that necessitate rectification and subsequent repeat testing etc.

(8) Immediately following the successful integrated Testing & Commissioning of the system or any constituent part, the Contractor shall complete the appropriate commissioning records in the agreed format and submit three signed copies to the Employer's Representative.

(9) The Contractor shall submit requirements and procedures to the Engineer, in respect of the Contractor's scope of work, for Integrated System Tests in conjunction with the Interface Contractors to demonstrate that the complete system provided under the Contract is fully operational and meets the specified performance criteria.

(10) Tests on Completion shall also include Integrated Testing. The Contractor shall, following satisfactory completion of tests on his Works, equipment, sub-systems or system, perform, at the direction of the Engineer, programme 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.

(11) The conducting of these Integrated System Tests, by the Contractor and the Interface Contractors, shall include a period of Test running. Necessary interfacing required with the other contractors shall be done by the Contractor as detailed in **Part 2 "Employer's Requirement, Section V(A), Volume 6, Appendix 3 - Design and Construction Interfaces" and in Particular Specification V(B).**

(12) **Completion of Test Results: The** results of the Integrated Testing and Commissioning shall be compiled and evaluated by the Engineer and the Contractor.

(13) **Retesting:** If the Works, or a part thereof, or a section, fail to pass the Integrated Testing and Commissioning, the Engineer shall require such failed tests, to be repeated under the same terms and conditions. If such failure and retesting result from a default of the Contractor and cause the Employer to incur additional costs,

the same shall be recoverable from the Contractor by the Employer, and may be deducted by the Employer from any payment due, or to become due, to the Contractor.

(14) **Failure to pass Test :** If the Works, or a part thereof, or a Section, fail to pass Integrated Testing and Commissioning and the Contractor in consequence proposes to make any adjustment or modification to the Works or a part thereof, or a section, the Engineer may instruct the Contractor to carry out such adjustment or modification, at his own cost or to other contractor(s) if the item(s) of Works is attributable to other contractor(s) and to satisfy the requirements of Integrated Testing and Commissioning within such time as the Engineer may deem to be reasonable.

(15) **Statutory Requirement:** The Contractor along with others 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.

(16) During integrated testing, the Contractor shall be required to carry out coordination with all interfacing contractors and agencies

19.4.7 Trial Running and Commissioning

(1) Following satisfactory completion of the acceptance Tests and the Integrated System Test, the Employer will commence an extended period of trial running to prove all technical systems, to the satisfaction of the CRS or any other Authorized Official, and to allow all technical systems to settle and to train staff in working procedures. The Contractor shall allow for attendance in respect of the Contractor's scope of work over the whole of this period, which may be expected to include repair activities and also further opportunity for technical staff training.

(2) The particular requirements for tests to be undertaken during the Service Trial are prescribed in the PS.

(3) The Contractor shall provide special and general attendance to the Employer and the Engineer during the Service Trial period as required by the PS.

(4) The Contractor shall co-operate with the Employer and the Engineer and with all interfacing parties to ensure that the proposed Service Trial programme and schedule truly demonstrates that the full, specified performance requirements and operating parameters are achieved.

(5) The Contractor shall review and comment on the Engineer Service Trial Plan and shall identify specifications, standards, method statements, procedures, pass / fail criteria, to the Engineer for inclusion in the Plan.

(6) The Contractor shall not interfere with the Service Trial tests and Validations in any manner. Any need for remedial works required to be performed by the Contractor shall be co-ordinated with the Employer and the Engineer in advance.

(7) Immediately following the successful tests of the system or any constituent part during Service Trial the Contractor shall complete the appropriate commissioning records in the agreed format, submit three signed copies to the Engineer and may then apply for the Taking Over Certificate in accordance with the requirements of the GCC.

19.5 Test Equipment and Facilities

(1) The Contractor shall provide all equipment and services required for testing, including, but not limited to:

i. Laboratory test instruments.

ii. Special test equipment, emulators, simulators and test software, to permit full testing of System functions and performance.

iii. Other items of the System, specified elsewhere as being part of the Contractor's supply, even if not part of the Subsystem under test.

iv. Consumables.

(2) All test instruments shall be subject to routine inspection, testing and calibration by the Contractor.

19.6 Witnessing by the Employer and the Engineer

19.6.1 Notice for Trial, Inspection and/or Test to the Engineer

(1) In relation to all Quality Control Points and Quality Hold Points involving inspection and/or testing by the Contractor, the Contractor shall give the Engineer notice of when the relevant work will be inspected and/or tested. The period of notice shall be as stated in the PS or such period as in the opinion of the Engineer is reasonable and notified to the Contractor. In the absence of any such statement or notice, a reasonable period of notice shall be given by the Contractor.

(2) In relation to all inspection and/or testing notified by the Contractor, the Employer and the Engineer may elect to witness such inspections and/or tests but the Contractor may proceed with the inspections and/or tests notwithstanding the absence of the Employer or the *Engineer* or of any response to the said notice.

(3) If the Contractor is in any doubt whether inspection and/or testing by the *Engineer* is required as a Quality Hold Point, the Contractor shall request that the *Engineer* clarifies his requirements prior to submitting the relevant inspection and testing plan for review, and in any event not later than 30 days.

19.6.2 Timing for Inspection and/or Test by the Employer and the Employer's Representative

(1) The Contractor shall allow the Employer and the Engineer a reasonable time to carry out any inspection and/or testing and to assess the result of any inspection and/or test before proceeding with the Works.

(2) Unless the Employer's Representative's prior review without objection has been obtained, all inspections and/or tests to be carried out or witnessed by the Employer and the Engineer shall be carried out between 0800 and 1800 hours.

19.6.3 Failure to Notify the Engineer

The Employer or the Engineer may reject the test and test results in question, and require the test to be repeated in the event of any failure by the Contractor to notify the Engineer.

19.7 Failures

(1) The Contractor shall rectify all the faults found during testing, and shall arrange for the relevant tests to be repeated. The relevant tests shall only be repeated when the fault has been remedied and the equipment demonstrated to function correctly.

(2) Where remedial measures involve significant modifications that might, in the Engineer's opinion, affect the validity of earlier tests, the Contractor shall repeat the earlier tests and obtain results satisfactory to the Employer and the Engineer before repeating the test in which the fault was first identified.

(3) The Employer or the Engineer shall have the right to order the repeat or abandonment of any test in the event that results demonstrate that the equipment is significantly non-compliant with the Contract.

(4) The Employer or the Engineer shall have the right to suspend any test in the event that errors or failures have become unacceptable. The Employer or the Engineer shall also have the right to suspend any test if a fault was detected by the Contractor but not reported to the Engineer within 24 hours of the detection. In this event, the suspension shall remain in effect until reporting has been brought up to date to the satisfaction of the Employer and the Engineer.

19.8 Repeat Tests

(1) The Contractor shall correct and re-test every fault detected during the tests.

(2) If the test results in a failure of the item under test the provisions of GCC clause 7.5 shall apply.

19.9 Fault Log

(1) The Contractor shall maintain a fault log throughout each series of tests. Every fault detected during the tests will be entered in the log, together with the actions taken to clear and re-test the fault.

(2) The fault log will be retained as part of the permanent quality assurance record for the system and be subject to regular inspection by the Engineer.

19.10 Hardware Failure Reports

(1) For each hardware failure that occurs at any stage of testing, the Contractor shall investigate the failure and prepare a report on its cause(s) and design implications, if any, resulting from such failure. The report shall clearly show:

(a) the observed symptoms;

(b) the most likely cause of the failure;

(c) an analysis of any stress that may have been caused to other components of the equipment being tested as a result of the failure;

(e) whether the failure is a result of any component operating outside its design range; and

(f) whether any design changes should be made to avoid further failures.

(2) All such reports will be retained as part of the permanent quality assurance record for the system, which shall be subject to inspection by the Engineer.

19.11 Software Failure Reports

(1) For each software failure that occurs, once the software has been reviewed without objection for inclusion into the system and is subject to configuration control, the Contractor shall generate a software failure report.

(2) All such reports will be retained as part of the permanent quality assurance record for the system, which shall be subject to inspection by the Engineer.

(3) The report shall clearly show:
- (i) the observed symptoms;
- (ii) the likely cause;
- (iii) the operator input.

(4) The report shall also clearly show the following information which shall be entered when the failure has been investigated:

- (i) the actual cause of the failure;
- (ii) the corrective action taken; and
- (iii) all software modules affected.

20.0 RECORDS

20.1 Records of Tests and Reports

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

(2) The format of the records shall cover all tests, provide positive identification by serial number for assemblies and sub-assemblies of the Permanent Works and show modifications to Employer's Drawings and diagrams or "as built" data to be certified by the Employer or the Engineer in the course of installation, testing and setting to work of the Works.

(3) The Contractor shall, during the execution of the Works, prepare such reports and records of design, manufacture, installation and testing as may be required in order that a license may be issued or statutory requirements may be met or approval given. Such reports or records shall be adequate to enable each part of the Permanent Works to be commissioned and to meet the requirements of the licensing authority or any standing statutory regulations, and shall be reviewed by the Employer and the Engineer.

(4) The Contractor shall obtain reports of each inspection and/or test. Such reports shall show the results of all the inspections and/or tests carried out and shall certify that the work has been inspected and/or tested in accordance with the requirements of the Contract and that the work complies with the requirements of the Contract.

(5) Any analysis of the results required to confirm that the work complies with the requirements of the Contract shall be compiled and reported to the Engineer.

(6) A representative of the Contractor who has been allocated the required authority under the relevant quality plans shall sign each report of inspection and/or test.

(7) In addition to any other requirements, the report shall contain the following details:
- a) material or part of the Works tested;
- b) location of the batch from which the samples were taken or location of the part of the Works;
- c) place of testing;
- d) date and time of tests;

e) weather conditions in the case of in-situ tests;
f) technical personnel supervising or carrying out the tests or inspection;
g) size and description of samples and specimens;
h) method of sampling;
i) properties tested or inspected;
j) method of testing or inspection;
k) all relevant checklists and work sheets used during the inspection and/or test , including readings and measurements taken during the tests;
l) test results, including any calculations and graphs;
m) specified acceptance criteria; and
n) Other details stated in the Contract.

(8) 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

20.2 Drawings produced by the contractor

(1) Drawings produced by the Contractor including drawings of site layouts, Temporary Works, etc. for submission to the Engineer shall generally be to ISO A1 size. However for smaller size drawings other size ISO A2/A3/A4 can also be submitted if agreed by the Engineer.

(2) They shall display a title block with the information as detailed in **Part 2 "Employer's Requirement, Section V, Volume 6, Appendix 7 - Drawing and CAD Standards"**.

(3) The number of copies to be submitted to the Engineer shall be as stated in the Contract, or as required by Engineer.

(4) The contractor shall provide three sets of "As Built Drawings along with read only electronic version of the same on CD/DVD to the Engineer.

20.3 Progress Photographs and Videography

(1) The Contractor shall provide monthly progress photographs which have been properly recorded to show the progress of the works to the Engineer. All important events shall be photographed.

(2) Two sets of photographs shall be provided on CD ROM format with two sets of colour prints of 175 mm x 125 mm size.

(3) The Contractor shall mount each set of each month's progress photographs in a separate album of a type to which the Engineer has given his consent, and shall provide for each photograph two typed self-adhesive labels, one of which shall be mounted immediately below the photograph and one on the back of the photograph.

(4) Each label shall record the location, a brief description of the progress recorded and the date on which the photograph was taken.

(5) All photographs shall be taken by a skilled photographer whose name and experience shall be submitted to the Engineer for consent and approval received.

(6) Photo processing shall be carried out by a competent processing firm to the satisfaction of the Engineer.

(7) The Contractor shall ensure that no photography is permitted on the Site without the agreement of the Engineer.

(8) Important events, construction activities, site visits of VIPs, working of new machinery, weather effects or any occasion advised by the Engineer shall be video graphed. The

recording shall be done or converted to .avi format and presented in a CD/DVD with appropriate voice recording describing the event.

20.4 Records of Wage Rates

(1) The Contractor shall keep monthly records of the average, high and low wage rates for each trade/tradesman employed on the Site and records shall be made available to the Engineer during inspection.

21.0 DEFECT NOTIFICATION PERIOD

(1) After the Works are taken over by the Employer in terms of Para 10.1 of General conditions of Contract (GCC) it will be followed by the **Defect Notification Period.**

(2) During this period Contractor shall replace/ remedy the defects occurring under normal usage of Works by the Employer, except for normal wear and tear under such usage.

(3) Maintenance activities to be done during Defect Notification Period shall be done by the Employer at its own cost and through separate agency.

(4) The Contractor shall submit a manpower plan showing the Contractor's organization available during Defect Notification Period.

(5) The Contractor shall attend the Monthly Meeting with the Engineer to discuss the defects arising during the Defect Notification Period. The dates and agenda of the meeting shall be agreed with the Engineer.

22.0 OPERATION & MAINTENANCE SUPPORT PLAN

(1) The Contractor shall provide an operation and maintenance (O&M) support plan that shall include such items as:

(a) Procedures for O & M for each item, unit / equipment including routine inspection, periodical overhaul and test running;

(b) Technical manuals;

(c) Initial provision of spares, facilities, test equipment, tools, jigs and fixtures.

(d) Manpower required for maintenance

(e) Training requirements;

(f) Procedures for removal and replacement of components;

(g) Periodic running of equipment and machines which would otherwise deteriorate because of non-operation for extended periods.

(h) Procedure for handling break downs.

(i) On completion of the Works the Contractor shall deliver to the Engineer copies of all manufacturing drawings, schedules and software for all components, as well the As-Built Drawings as specified in PS.

(2) Spares List

(a) The Contractor shall submit a schedule of recommended spare parts required duly indicating the quantities required for each item of spares, its description, part number, drawing number, lead time, shelf life and number of units required for the period of five years (beyond DNP), name and addresses of principal as well as secondary sources of supply of each spare.

(c) This recommended schedule shall include all types of consumable, unit exchange and emergency spares, the Contractor shall also advise the

recommended inventory having regard to the lead time of the respective items.

(d) The Contractor shall:

- Submit to the Engineer a list of spares required for the life of the plant & equipment, manufactured items and system / sub-system;
- Base the spares calculations on the reliability and availability data and the criticality of the equipment;
- Submit to the Engineer for review the calculations of quantities required and the proposed spares list;
- Submit to the Engineer a system for easy identification of spares.
- The contractor shall establish computer based spare inventory plan to manage the contract spare inventory by employer.

(e) The Spares list shall:

- be grouped by plant & equipment, manufactured items and system / sub-system, test equipment and special tools as applicable for stocking identification;
- have detailed description with drawing references and correlation with the maintenance manuals.

(f) In the event that any of the spares identified have a particular shelf life or special storage requirement, this shall be made known to the Engineer with the submission of the spares list, including the necessary action for disposal or storage.

(g) All spare equipment identified on the spares list, shall conform to Identification and Configuration Control requirements established by the Contractor for the equipment provided under the Contract.

23.0 OPERATION AND MAINTENANCE (O&M) MANUALS

23.1 In addition to the various existing Codes and Manuals applicable to Indian Railways for operation and maintenance of Traction Supply, OHE, Signaling, Telecommunication, SCADA & General Power Supply Services equipment, the Contractor shall produce additional Manuals covering the additional provisions (if any) 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.

23.2 With reference to the requirements as above:

(a) The Contractor shall produce manuals for all equipment and manufactured items, and sub-systems supplied (if any) for their efficient operations and maintenance. These shall include, but may not necessarily be limited to, the following:

- Manual for maintenance of Signalling System
- Manual for maintenance of Telecommunication System
- Manual for maintenance of GSM-R System
- Operating/User Manuals - broken into as many sub-sections as may be necessary and providing sufficient information to enable non-technical staff to exploit fully the facilities of each system.
- Workshop Manuals - installation and circuit descriptions, full schematics, circuits, wiring diagrams, mechanical construction

drawings and itemized parts list to enable all maintenance rectification and setting-up to be carried out.

- Software System Manuals - for each software package and each piece of equipment which incorporate programmable devices, 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".
- Equipment Room Manuals - all wiring diagrams and circuits, equipment layout, terminal and cable listing and including such external equipment as may be necessary for completeness.
- Maintenance and Servicing Manuals - to specify requirements, procedures and servicing intervals for planned preventative maintenance and in addition to convey sufficient information on equipment principles and practice to enable first line fault diagnosis and rectification by technician staff.
- Configuration manual.

(b) Operation & Maintenance manual shall also contain the following

- Technical description of each sub- system and item of equipment installed, written to ensure that the Employers staff fully understands the scope and facilities provided.
- Diagrammatic drawings of each sub-system indicating principle components and items of equipment
- Name, addresses, telephone, e-mail and fax numbers of the manufacturer of every item of equipment
- 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
- Procedures for fault location and isolation
- Maintenance procedures and their periodicity.
- Tools and Plant needed for maintenance of different Equipment and components.
- All test results conducted on the relevant equipment whether at the manufacturer's place or at site
- 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.

(c) The sub-systems / systems and Operating/User Manuals and a summary (suitable for use at technician level) of the Maintenance and Servicing Manuals shall be prepared in both English and Hindi languages unless otherwise instructed by the Engineer.

(d) The Contractor shall submit all the Manuals for review by the Engineer prior

to Factory Acceptance Tests which shall be submitted not later than 4 months from the targeted date of start of Trial Running for the Engineer's consent.

(e) The Contractor shall provide six controlled copies of all Manuals along with Electronic version for the use of the Engineer.

(f) The Contractor shall maintain all Manuals in an up-to-date condition throughout the Contract Period wherever applicable.

(g) O&M Manuals and drawings as submitted by the Contractor shall be updated by him during the Defects Notification Period, if required, and shall be re-submitted to the Engineer for review without any extra cost to the Employer.

24.0 SPARES, SPECIALTOOLS, TEST EQUIPMENT AND M&P

This shall be as per Part 2 Vol. 7 & 8 Particular Specification. All spares, special tools and test equipment and M&P shall be consigned to the employer and delivered in accordance with the Engineer's instruction to a program which shall ensure that spares, special tools and test equipments and M&P are delivered to facilitate normal routine maintenance of the permanent works by the Employer at all stages of completion as defined in sub clause 8.2 of Section-VII Part-3.

25.0 TRAINING

This shall be as per Part 2 Vol. 7 & 8 Particular Specification.

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Section V(A). Employer's Requirement

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APPENDIX - 1

UTILITIES

1.0 All the chartered (visible) and unchartered (un-visible) utilities along the track alignment have been removed/Relocated by the employer. However any minor hindrances coming in the way of track alignment have to be removed or relocated by the Contractor at no extra cost.

2.0 The contractor will arrange the right of way/necessary working clearance of trees and other obstructions on either side of the alignment of the line including cutting/trimming of trees falling in the required corridor and obtaining their statutory clearance. During the construction works, there may be unavoidable damage to crops, trees etc. Compensation of this account, if any will be paid directly by the contractor. Any avoidable or deliberate damage done to standing crops or private property by the contractor's laborers shall be contractor's responsibility.

3.0 Any extra land required by the contractor temporarily for dumping of construction materials and consequent damage of crop etc. shall be the responsibility of the contractor. If any permission, permits are required to be arranged from any Govt. or Local authorities for smooth execution of the work, this will be arranged by the contractor as and when required. Jungle clearance/tree cutting, if any along the line shall be arranged by the contractor.

4.0 **Procedure for Removal of Trees**

i) The felling/re-plantation of trees is governed by the relevant preservation of trees legislation of the Government of India or the concerned Sate Government.

ii) If for the purposes of the S&T works trees are required to be cut/trimmed/re-planted or removed, the Contractor must notify the Engineer of the tree felling requirements.

ii) Subject to compliance with the aforementioned legislation, arrangements for tree felling may be made by the Contractor and appropriate replacement of felled trees, as required by the legislation shall also be made by the Contractor at his own cost.

iii) If any trees are required to be felled/re-planted, then such trees are to be identified by the Contractor and brought to the notice of Engineer in advance. Such trees shall be limited to those which cause a material adverse effect on the construction of Works.

iv) The Contractor shall obtain the applicable permits for felling/re-plantation of such trees from the concerned authorities and the Employer shall assist him in this regard.

v) The felled trees shall be deemed to be the property of Contractor unless deemed otherwise by the legislation vide item i) above.

vi) No cost for cutting/ replanting/ relocating of trees shall be paid to the Contractor as unchartered utility.

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APPENDIX - 2

WORKS AREAS AND CONTRACT STAGES

1. Works Areas

(1) The Contractor shall divide the Site into separate Works Areas/Railway Envelopes and shall elaborate a schedule for the time periods of the availability of these areas for his contract performance. This should be synchronized with the **Schedule of access to Site provided in Appendix to Tender – Part 3 of the Bid Document** taking account of the Contractor's co-ordination and integration responsibilities with the interfacing contractors.

(2) The Contractor shall indicate the exact nature of the various Works Areas and the extent of works to be carried out prior to the execution of the permanent S&T works or making use of the area as working space and/or for temporary Site facilities.

(3) The schedule as per (1) and (2) above shall include, but not limited to the following data:

a) Indication of the Works Areas;

b) Description and intended use of the Works Areas;

c) The start and the end date of the availability of the Works Areas, required by the Contractor;

d) The start and the end date of the periods in which the Contractor is to allow the Works Areas to be accessed by interfacing party(ies).

(4) The information as in (1) and (2) above shall be submitted as part of the Contractor's preliminary design and shall be subject to agreement by the Employer and approval by the Engineer.

(5) On the basis of the approved information as in (1) and (2) above the Contractor shall submit proposals for the use and the occupation of the Works Areas, such submissions being at least fifty six (56) days prior to the programmed use of the specific Works Area.

(6) Prior to the scheduled dates for returning of any of the Works Areas for subsequent use by an interfacing party, the Contractor shall carry out the following activities:

a) Construct all Permanent Works within the Works Area, to the extent as defined in the Definitive design and in accordance with the requirements of the Contract;

b) Reinstate the area to the same condition as it was taken over;

c) Form the area to the approved lines and levels and carry out such other works as may be required by the provisions of the Contract;

d) Remove all rubbish, debris and other materials.

e) Carry out and record jointly with the Engineer and interfacing contractors a condition survey of the area.

(7) Restrictions on the timing of occupation so as to avoid affecting operation will be made.

(8) Temporary electrical works provisions in Works Areas are detailed in **"Employer's Requirement, Section V(A), Volume 6, Appendix 8 – Temporary Power Supply"**.

(9) The interfacing parties shall be required to vacate the Works Areas at least 56 days before the due date for handing back of the Works Areas from the Contractor to the

Employer, thus allowing the Contractor to clear and reinstate the works areas in accordance with the Contract.

(10) Entry to and exit from the Site shall be controlled and shall be only available at the locations for which the Engineer has given his consent.

(11) The Contractor shall ensure that access to every portion of the Site is continually available to the Employer and Engineer.

(12) Other contractors engaged for project execution shall also be allowed to use the temporary facilities so created by him to access the Site without any consideration.

(13) Employer will take over the entire stretch/section as per para 10.1 of General Conditions of Contract.

(14) The Contractor shall be responsible for ensuring that any access or egress through the Site boundaries are controlled such that no disturbance to residents or damage to public or private property occur as a result of use of such access or egress by its employees and sub-contractors.

2. Standard Engineering Conditions

The following standard engineering conditions apply to all Works Areas:

a) Forming of Areas

i. The Works Areas shall be formed to the levels shown on the drawings. No levels shall be amended without prior consent of the Engineer.

ii. The Works Areas shall be surfaced in a manner agreed with the Engineer, compatible with their intended use, and, in particular, footpaths and roadways connecting facilities shall be provided.

iii. Measures shall be taken to the satisfaction of the Engineer to ensure all areas are properly drained and kept free of static water.

b) Roads and Parking

i. Space shall be provided within the Works Areas for parking, loading/unloading and maneuvering of motor vehicles.

ii. Any damage caused by the Contractor to the adjoining public roads and fixtures and properties (public or private) shall be made good to the satisfaction of the Engineer and its owner.

c) Drainage and Sewerage

i. All storm or rainwater from the Work Areas including any access roads thereto shall be conveyed to the nearest stream course, which has the necessary capacity, catch-pit, and channel or storm water.

ii. All temporary and permanent Works shall be carried out in such a manner that no damage or nuisance are caused by storm water or rain water to the Site and adjacent property.

iii. Damage or obstruction caused to any watercourse, drain, main or other water installations within or adjoining the Works Areas shall be made good to the satisfaction of the Engineer.

iv. Treatment and disposal of sewage and wastewater from the Works Area shall be provided to the satisfaction of the Engineer following the ecological requirements.

d) Buildings

i. No permanent structures other than those required for the Permanent Works shall be permitted on the Works Areas.

ii. The Contractor, as required, for all temporary buildings, shall provide electricity, water, telephone and sewerage.

e) Pedestrian Access

Any accesses or passing through the Works Areas shall be maintained in a usable condition at all times to the satisfaction of the Engineer including lighting, signing and guarding.

f) Fencing and Signboards

i. For executing the work in urban areas, the Contractor shall erect hoardings, fences and gates around its areas of operations to prevent entry by unauthorized persons to his Works Areas and necessary identity cards /permits should be issued to workers and staff by the Contractor.

ii. For executing the work in adjacent to running traffic areas, the Contractor shall erect fences and gates around its areas of operations to prevent accidents as well as post competent flagmen as detailed in **para 13.2 Part 2 "Employer's Requirement, Section V(A), Volume 5 – Manufacturing, supply, installation, Testing and Commissioning".**

iii. The Contractor shall submit proposal for fencing of the complete/ partial perimeter of all Works in any urban areas to the Engineer. No work shall be commenced in any Urban Area until the Engineer has been satisfied that the fencing installed by the Contractor is sufficient to prevent, within reason, unauthorized entry / accidents.

iv. For areas other than urban areas, the work Site shall be suitably fenced to prevent, within reason, unauthorized entry / accidents.

v. Project signboards shall be erected before commencement of the Works.

vi. The types, sizes and locations of project signboards shall be agreed with the Engineer before manufacture and erection. Other advertising signs shall not be erected on the Site.

vii. The consent of the Engineer shall be obtained before hoardings, fences, gates or signs are removed. Hoardings, fences, gates and signs which are to be left in positions after the completion of the Works shall be repaired and repainted as instructed by the Engineer.

viii. Hoardings, fences, gates and signs shall be maintained in good order by the Contractor until the completion of the Works, whether such hoardings, fences, gates and signs have been installed by the Contractor or by others and transferred to the Contractor during the period of the Works.

ix. All hoardings, fences, gates and signs installed by the Contractor shall be lit during night or low visibility as required and advised by the Engineer and removed by the Contractor upon the completion of the Works, unless otherwise directed by the Engineer.

x. Hoarding/fencing can be reused after removing from one place to other locations/Sites provided they are maintained in good condition and agreed by the Engineer.

xi. Damage/worn-out fencing/hoarding shall be replaced by Contractor within 24 hours. Engineer‘s decision regarding need for replacement shall be final and binding and if no action is taken by Contractor the cost of any repairs will be deducted by the Engineer from any payment due to the Contractor.

3. Contract Stages

(1) The Contractor shall divide the Works into Stages.

(2) These Stages shall be achieved by Key Dates/Milestones mentioned in **“Employer’s Requirement, Section V(A) , Volume 6, Appendix 4 – Project Program Requirements”**. For this purpose the Contractor shall elaborate a schedule of his own internal schedule to achieve these Key Dates/Milestones.

(3) The schedule of achieving these Key Dates/milestones as per the previous sub-item shall be submitted as part of the Contractor's Preliminary design and shall be subject to agreement by the Engineer.

(4) The schedule of Key Dates shall include, but not limited to the following data:

a) Stage identification;
b) Key Date No.;
c) interfacing parties (information to be provided by the Engineer);
d) Related bodies and/or organizations certifications/approvals;
e) Works to be performed and/or actions to be executed before the Key Date/milestone;
f) Intended achievements.

(5) Completion of works at a Key date/Milestone does not imply handing over of the appropriate Works Area to any other interfacing party.

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APPENDIX - 3

DESIGN AND CONSTRUCTION INTERFACES

1.0 General

1. 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.

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

   (i) 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.

   (ii) 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.

   (iii) Receipt from interfacing parties of such information as is reasonably required to enable Contractor to meet design submission schedule as identified in Part 2, Employer's Requirement, Section V(A), Volume 3 – Design Procedures and Processes

3 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 seven (7) calendar days from the date of such correspondence and meetings.

4 The Contractor shall provide sufficient information for 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 cannot be resolved by Contractor despite having taken all reasonable efforts, the decision of the Engineer shall be final and binding on the Contractor(s).

5 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.

6. 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.

7. 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.

2.0 Interface Management Plan (IMP)

1. 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.

2. 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. Interface Management Plan shall:
   (1) Identify the sub-systems as well as works and facilities with interfacing requirements.
   (2) Define authority and responsibility of Contractor's and all other contractors' (and any relevant sub-contractors') staff involved in interface management and development.
   (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 CST and other contractors' works.
   (4) Address Works Program of Contract to meet mile stones of each contractor and highlight any program risks requiring the Employer's attention keeping in view timeline of Contract.
   (5) Address the interface issues during Design and Construction.

4. The Interface Management Plan shall include procedures for identifying and resolving interfaces within the Contractor's scope of work between the Contractor and the Employer and between the Contractor and other contractor(s).

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

6. **Design Interface**
   (1) The Contractor shall commence the design interface with the interfacing contractor as soon as he has been notified by the Engineer that an interfacing contract has been awarded.
   (2) 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.
   (3) 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.
   (4) 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.

7. **Construction/Installation Interface**

(1) 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.

(2) 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.

8. **Employer's/Engineer's Input**

(1) The Engineer will coordinate the activities of the Contractor with reference to interfacing with other contractors and agencies during all the phases of the Contract.

(2) The Employer/Engineer, within the scope of the relevant Contract provisions, will support and assist the Contractor in the following fields:

(a) 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;

(b) Interfacing with State and local authorities for implementation of the additional land acquisition procedures;

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

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

3.0 Interface Management

(1) 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.

(2) An interface list shall be prepared and maintained by the Contractor and updated on a regular basis to reflect the actual needs of both parties.

(3) The Contractor shall co-ordinate all interface items on the list and agreed solutions with the other contractors.

4.0 Dedicated Co-ordination Team

1. The Contractor shall establish a dedicated co-ordination team led by a coordinator reporting to the Contractor's Project Director.
2. 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.
3. 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.
4. 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.

5. 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.
6. The complexity of the project and the importance of ensuring that work is executed within the stipulated time require detailed programming and monitoring of progress so that early program adjustments can be made in order to minimize the effects of potential delays.
7. 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.

5.0 Coordination with other Contractors and Indian Railways

1. The Contractor shall undertake design co-ordination with other contractor(s) and Indian Railways.
2. The Contractor may commence design interfacing with other contractors and Indian Railways prior to the given period once information has been developed to a level where meaningful interaction can take place.
3. Design co-ordination shall include, but not be limited to, the following:
   (1) Definition and agreement with other contractors of interface areas and contract limits;
   (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) Agreement of combined service drawings and structural opening drawings.
4. The Contractor shall liaise with the Engineer in developing a uniform identity code system which shall be used to uniquely identify each item of equipment and software component provided under this Contract and provided by the other contractors and/or Indian Railway.
5. Such identity codes shall be used for labeling each item of equipment and shall also be used in design reports, drawings and operations and maintenance manuals. Such codes shall comprise mnemonics for location names and equipment types as well as alpha-numeric for unique numbering.
6. The Contractor shall undertake Site activity co-ordination with the other contractors and/or Indian Railways within the periods stated for access and installation interfacing and co-ordination in the agreed CIP.
7. The Contractor shall undertake installation and testing in accordance with the milestones set in the Contract and the dates in the CIP and as agreed with the other contractors and/or Indian Railways.
8. The Contractor shall undertake a lead role in the co-ordination of the activities associated with integrated S&T systems testing including the co-ordination of other contractors and/or Indian Railways to test and monitor their systems to prove the design and integrity of the systems as a whole.
9. It shall be the responsibility of the Contractor to secure from the other contractor(s) and/or Indian Railways, in a timely and correct manner as per the agreed CIP, whatever interface provision is required for the Contractor to carry out its duties under the Contract.

10. Any additional cost arising to the Contractor due to his late and/or improper interfacing with the other contractor(s) and/or Indian Railways, shall be to the Contractor's account. Such improper interfacing shall include, but not be limited to:
    (1) Late provision of interfacing information
    (2) Failure to adhere to agreed interface
    (3) Changing an interface after it has already been agreed and signed off.

6.0 Signalling and Telecom Systems Interface Requirement.

1. The Contractor shall coordinate with other contractors working in the section viz. CST Contractor(s) for Buildings & Structures and Track, the Electrical Contractor for E&M, Electrification and Power Supply, any other contractor engaged by Employer for Deen Dayal Upadhyay-New Bhaupur section. The Contractor shall also coordinate with Indian Railways officials, government departments etc., as required, for timely completion of the Work.

2. The Contractor shall associate with Electrical Contractor (CP-204)for the preparation of the Project wide EMC/EMI Management Plan, Bonding and Earthing Management Plan and S&T Systems Integration Plan. The Contractor shall assess the risks and shall be responsible for their inclusion in the 'Interface Management Plan (IMP)' and 'Interface Coordination Document (ICD)' to be prepared by the Contractor.
3. The Contractor shall ensure that the issues/information pertaining to them that have been included in the IMP and the ICD, are timely exchanged/resolved and have no bearing on the Works Programme.
4. It would be the responsibility of the Contractor to settle all disagreements with the Other Contractor(s). If such disagreement cannot be resolved by the Contractor, despite having made all reasonable efforts, then the decision of the Engineer shall be final and binding on the Contractor.
5. Interface with Civil Structures and Track(CST) Contractor(s)

The Contractor shall have to exchange information with CST Contractor(s) for the following, but shall not be limited to:

(a) Regarding track alignment, cant, versine, track geometry, rail levels, gradient, curve details, track center along with transition curve details.

(b) Right of Way and Access free of encumbrances to sites on Main Line and at Stations.

(c) HDPE/GI Pipes below tracks of requisite size for track-crossing of Signalling& Telecom Cables.

(d) The S&T requirement of Track, Track Alignment, Points & Crossings, Service Buildings, Yard Layouts etc., including the access dates and various milestone dates so as to co-ordinate the S&T Works under this Contract.

(e) All the information regarding S&T design and execution, which may be reasonably needed by CST Contractor(s) to design and execute their works under their Contract.

Contractor's Interface with CST Contractor(s) shall, but not be limited to the following:

S.No.	Interface Subject	Signalling& Telecom Contractor (CP-203R	CST Contractor	Document
1	Design and Construction of Signalling Equipment Room(SER), Telecom Equipment Room(TER) and S&T Power Supply Equipment Room(s) as part of Station Building at Stations.	1. Shall provide the requirement of ventilation and flooring. 2. Shall provide the requirement of cable ducts in the floor & cable-entry locations in the rooms. 3. Shall advise the size and location of cable pits being constructed at cable inlet points.	1. Shall design and construct the rooms.	
2	Design and Construction of additional Signalling structures in Station area	1. Shall decide the location for construction of any additional Signaling structures in Station area in coordination with the CST contractor. 2. Shall construct these additional Signalling structures in Station area.	1. Shall incorporate this requirement in relevant drawings.	Approved Site Plans for the SER/Power Supply Rooms.
3	Design and Construction of Telecom Equipment Room(TER) and Telecom Power Supply Equipment Room(s) at IMDs, IMSDs, and Staff Residential Colonies.	1. Shall provide the requirement of ventilation and flooring. 2. Shall provide the requirement of cable ducts in the floor & cable-entry locations in the rooms. 3. Shall advise the size and location of cable pits being constructed at cable inlet points.	1. Shall design and construct the rooms.	
4	Signalling Equipment Room(SER), Telecom Equipment Room(TER) and S&T Power Supply Equipment Room(s) in Block Sections and at Interfacing IR Stations.	1. Shall decide the location(Site Plans) for construction of SER, TER and Power Supply Equipment rooms in coordination with the CST Contractor. 2. Shall construct these SER, TER and Power Supply Equipment rooms.	1. Shall incorporate this requirement in relevant drawings.	Approved Site Plans for the SER/TER/Power Supply Rooms.

5	Radio Towers at Stations and in Block Sections.	1. Shall provide requirement of the location and space for Radio Towers. 2. Shall construct the Radio Towers.	1. Shall incorporate this requirement in relevant drawings.	
6	Trenching for trackside cable laying.	1. Shall decide the route of cable trenching in coordination with the CST contractor. 2. Shall carryout trenching for trackside cable laying.	1. Shall provide route for trenches as required by S&T for their cable laying. 2. Shall provide drawings for any underground services laid by him.	Cable Route Plan
7	Track Alignment and Yard Plans	Shall advise modifications to yard plans if required from Signalling point of view duly approved by Engineer.	Shall modify the yard plans as per Signalling requirement duly approved by Engineer.	CST Contractor shall incorporate modifications in yard plans and shall process for their validation.
8	Cable passage requirement on bridges/culverts	Shall draw out sketches and provide to CST Contractor for requirement of cable laying on bridges/Culverts	Shall provide space for laying GI pipes/ Troughs on bridges, and shall provide Cable Ducts on Culverts.	S&T Contractor shall provide drawings showing requirements for cable running on bridges/culverts.
9	Point Machines installation	Shall coordinate with CST contractor for installation of Point and Point fittings as required by Signalling for Point machine installation and commissioning.	Shall provide Points and Point fittings as required by Signalling for point machine installation and commissioning.	Indian Railways Signal Engineering Manual
10	Testing of Points	Shall jointly test Points with CST Contractor during integrated testing & commissioning and rectify all Signalling defects as required during testing.	Shall jointly test the Points with S&T Contractor and rectify any track-related defects identified during testing	

11	Electrical Parameters of track/ turn-out related assemblies	Shall furnish the requirements of electrical parameters of track assembly for track circuit (if provided)	Shall provide the track parameters including, but not limited to Ballast resistance, sleeper insulation etc., as required by S&T.	
12	Glued joints for Track Circuits (if provided)	Shall furnish requirement and locations of Glued Joints/Insulated Joints (if any)	Shall provide Glued Joints /Insulated Joints at locations specified by S&T (if any)	
13	Track/Road/Platform crossing of cables.	1. Shall decide the Track/Road/Platform crossing route, required for S&T work, in coordination with the CST contractor. 2. Shall carryout these Track/Road/Platform crossing.	1. Shall provide route for Track/Road/Platform crossings of S&T Cables, as per their requirement. 2. Shall advise location of RCC pipes as laid by them for S&T cable crossings.	
14	Marking center-line of track and locations of stock joints.	Line-side installations shall be carried out in coordination with the CST Contractor.	Shall provide the center-line and Stock-Joint locations.	
15	Center-lines of Road and rail tracks at level crossings	Shall Install lifting barriers, sliding boom and road signals at the proposed level crossings as per the markings given by CST Contractor	Shall provide firm markings of rail tracks and road center lines to the S&T Contractor. Shall provide Road Sign Boards.	A jointly signed drawing showing the centre-lines of rail tracks and the road with respect to a permanent land mark.

Note: The detail of build/partially build/completed building structure has been provided under Appendix-15, Part-2, Section V(A). Any alteration/addition shall be done by the S&T Contractor.

6. Interface with Traction Electrification and E&M Contractor (CP-204)

The Contractor shall interface with Traction Electrification and E&M Contractor(CP-204) to;

(1) Provide information to Contractor CP-204, on Signals Locations/Implantation, Locations of S&T Equipment Rooms and requirement of Power for S&T installations in EDFC Phase-2, specifying the dates by which the E&M installations and their energisation is required.

(2) Provide space for installation of 'Change-Over' Switches at S&T Service Buildings.

(3) obtain information from Traction Electrification and E&M Contractor (CP-204), about the OHE Mast Plan, HT Cables and EMI/EMC Study carried out by him.

(4) Exchange information and interface on EMI/EMC studies carried out by Contractor and by Traction Electrification and E&M Contractor (CP-204), to decide upon and mitigate ill-effects of Electro-Magnetic Interference on Signalling& Telecommunication installations.

(5) Contractor's Interface with Traction Electrification, E&M Contractor (CP-204) Contractor(s) shall, but not limited to the following:

Item No.	Item Description	Signalling& Telecom Contractor (CP-203R)	Traction Electrification, E&M and associated Works Contractor (CP - 204)	Reference Document if any
1.	Signals on Insulated Overlaps	Shall locate Signals taking into account location of insulated overlaps	Shall share information on location of insulated overlaps.	
2.	Signals for Neutral Section	1. Shall share the location of Signals for determination of layout of Neutral section. 2. Shall adjust location of Signals as per layout of Neutral section.	1. Shall share Layout Plan of Neutral section for determination of Location of Signals. 2. Shall adjust Layout of Neutral section as per the Location of Signals.	1. Signal Interlocking Plan 2. Layout Plan for Neutral section
3.	EMI/EMC interface Signalling& Telecom cable details	1. Shall perform the EMC simulation study for S&T system, prepare EMC/EMI Management Plan identify needs & measures and implementation thereof. 2. Shall coordinate with other contractors and collect all the information as required for EMC/ EMI study	1. Shall perform the EMC simulation study for Traction, prepare EMC/EMI Management Plan identify needs & measures and implementation thereof. 2. Shall coordinate with S&T and collect information as required for EMC/EMI study 3. Shall share the information about HT Cables and OHE	
4	Bonding and Earthing Plan	Shall Design the Bonding and Earthing Plan in coordination	Shall Design the Bonding and Earthing Plan in coordination with the	

Item No.	Item Description	Signalling& Telecom Contractor (CP-203R)	Traction Electrification, E&M and associated Works Contractor (CP - 204)	Reference Document if any
		with the Electrical Bonding and Earthing Plan.	Earthing and Bonding Plan of S&T	
5	OHE mast locations	1. Shall prepare the Signalling Plan in coordination with OHE Layout Plan.	Shall prepare Layout Plans of OHE in coordination with Signalling plan showing mast locations, wire staggers etc., including extra mast implantation needed if any for the Signal.	Signal Interlocking Plan OHE Layout Plan
6	LT Power Supply, E&M and associated work including Fire Detection & Alarm System for S&T installations at Stations, IMDs and IMSDs.	1. Shall provide information of S&T Equipment load requirement at Stations, IMDs and IMSDs. 2. Shall advise the requirement of Electrical fittings including Lights, Fans, Sockets, Air-Conditioner etc. in S&T Structures at Stations, IMDs and IMSDs.	1. Shall design and provide LT power supply to S&T system at Stations, IMD and IMSD as per S&T load requirement. 2. Shall provide Electrical fittings including Tube lights, Fans, Sockets and Air-Conditioner as per S&T requirement in S&T Structures at Stations, IMDs and IMSDs. 3. Shall provide Fire Detection & Alarm System in SER, TER and S&T Power supply equipment rooms	
7	LT Power supply, E&M and associated work	1. Shall advise space for positioning the ACO.	1. Shall provide the ACO in coordination with S&T.	

Item No.	Item Description	Signalling& Telecom Contractor (CP-203R)	Traction Electrification, E&M and associated Works Contractor (CP - 204)	Reference Document if any
	including Fire Detection &Alarm system for S&T installations at other than stations.	2. Shall share the S&T Equipment load requirement including requirement of Lights, Fans and Air-conditioning. 3. Shall advise the requirement of Electrical fittings including Lights, Fans, sockets etc. in Signalling and Telecom structures.	2. Shall design and provide LT power supply to S&T system as per their load requirement. 3. Shall provide the Electrical fittings including Lights, fans, sockets etc. in Signalling and Telecom structures, as per S&T requirement. 4. Shall provide Fire Detection & Alarm System in SER, TER and S&T Power supply equipment rooms.	
8	Power Cable crossings	Shall take necessary precautions while laying the S&T Cables	Shall provide information of all Power Cable crossings along the track	Cable Route Plan
9	Communication channel/ bandwidth requirement for CCTV, Traction SCADA and Auxiliary SCADA	Shall provide fiber channels, bandwidth and also fiber line interface units as required.	Shall furnish their requirement of fibers, channels, bandwidth with details of locations where it is required.	Fibers/channel allocation diagram
10	Video Display System	Shall provide Video Wall Panels as required including display controller for display of SCADA information.	Shall coordinate and provide all SCADA information required to be displayed on the Video wall at Display controller provided by S&T.	

Item No.	Item Description	Signalling& Telecom Contractor (CP-203R)	Traction Electrification, E&M and associated Works Contractor (CP - 204)	Reference Document if any
		Note: video wall already installed can be used. If any alteration/addition required, shall be carried out by the contractor		
11	Provision/Configuration of Direct Line Consoles/Telephones of Traction Power Installations	Shall provide Direct Line Consoles/Telephones for Traction Power Installations	Shall provide information about requirement of Direct Line Connectivity amongst Traction Power Installations.	

7. Contractor shall interface with System Works Contractor for Bhaupur-Khurja Section(Contract Package CP-104) for integration of Signalling& Telecom System as per the requirements stipulated in Particular Specification-Signalling Works and Particular Specification-Telecommunication Works.

8. Interface requirements specified above are by no means exhaustive and it remains the Contractors' responsibilities to develop, update and execute jointly Interface Requirements during design & throughout the execution of Works, to ensure that:

   (1) all interface issues between the Contracts/Systems are satisfactorily resolved;

   (2) design, supply, installation and testing of equipment are fully co-ordinated; and

   (3) all equipment and facilities supplied under the Contracts are fully compatible with each other, whilst meeting the requirements of the respective Specifications.

9. Interface Requirements with Indian Railway

   (1) Contractor shall liaison with designated authorities in Indian Railway to design Signalling & Telecom Arrangement for/at LC Gates serving both Indian Railway and DFCCIL. The design so finalised shall be submitted to Engineer for review. The contractor shall execute the so reviewed Telecom Arrangement for/at LC Gates serving both Indian Railway and DFCCIL.

   (2) Contractor shall liaison with designated authorities in Indian Railway to develop integrated design of Mobile Train Radio Communication System based on GSM-R System as stipulated in relevant chapter of Particular Specification for Telecommunication. The design so finalised shall be submitted to Engineer for review. Contractor shall further liaison with designated authorities in Indian Railway for Installation, Testing & Commissioning of this integrated GSM-R System.

   (3) Contractor shall liaison with designated authorities in Indian Railway to design Signalling and Telecom Arrangement for/at boundaries with Indian Railways. The design so finalised shall be submitted to Engineer for review. The contractor shall execute the so reviewed Telecom Arrangement for/at boundaries with Indian Railways.

APPENDIX - 4

PROJECT PROGRAM REQUIREMENTS

1.0 General

(1) In accordance with the General Conditions of Contract Clause 8.3 the Contractor shall submit his detailed time program to the Engineer within twenty eight (28) days of the Commencement Date of the Works.

(2) The Programme as per the previous sub-item (1) above shall be supplemented at the time of the Contractor's Preliminary Design submission by **Part 2 "Employer's Requirement, Section V(A), Volume 6, Appendix 2 – Work Areas and Contract Stages" ,** duly approved in accordance with the contract provisions, these appendices becoming an inseparable part of the said Programme.

(3) In compiling its Works Programme and in all subsequent updating and reporting, the Contractor shall make provision for the time required for co-ordinating and completing the design, construction, procurement, manufacture, supply, installation, testing, commissioning and integrated testing of the Works.

(4) This period shall include but not be limited to design co-ordination periods during which the Contractor shall co-ordinate its design with those of interfacing parties, review procedures, determining and complying with the requirements of all government departments and obtaining all necessary permits.

(5) This period will include co-ordination with all others whose consent, permissions, authority or license is required prior to the execution of any work.

(6) The Works Programme shall take full account of the Design submission programme.

(7) This supplementing, however, shall not relieve the Contractor from his obligation to observe the overall Contract performance term as mentioned in Contract conditions.

(8) The Contractor shall, during the progress of the Works, constantly monitor his progress against the programmes described below.

(9) The Works Programme, and all more detailed or revised versions, shall be submitted to the Engineer for his consent in accordance with the provisions of the conditions of Contract.

2.0 Milestones

Milestones have been derived from clauses 8.2, 8.7 and 10.1 of Conditions of Contract. These are the broad key deliverables and Contractor is required to develop project program to achieve these deliverables and dates. Accordingly contractor should set his own internal targets which are commensurate with these Milestones and incorporate in his all internal schedules for approval of Engineer. The details of Milestones and Key Dates are mentioned under appropriate clauses in Section VII, Part 3 of Bid Document.

3.0 Works Programme

i. The Works Programme to be submitted under the contract shall be developed from the Outline Works Programme submitted and developed during the tender period.

ii. 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.

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

iv. 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.

v. 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.

vi. 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 Contractors design, procurement, installation, commissioning and setting to work. As a minimum, it shall include'

(1) All works comprising the permanent works;

(2) Preparation, submission and review of Design Documents showing all items where review by the Engineer is required.

(3) Procurement of all major materials and items of Contractor's Equipment for the Works, including the dates orders are to be placed, manufacture period and the expected delivery date to the Site for each item.

(4) Any software development requirements and Validation time frames.

(5) All manufacture or prefabrication of materials of components.

(6) All design and installation of major Temporary Works.

(7) All activities associated with securing necessary permits and other statutory approvals for the works.

(8) Access and availability dates for all Project Contractors.

(9) All interfaces related to the project that may affect the progress of the Works.

(10) Testing and commissioning activities requirements.

(11) Training.

vii. 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:

(1) Design Submission Programme

(2) Procurement and Manufacturing Programme;

(3) Installation Programme

(4) Testing and Commissioning Programme; and

(5) Training Programme

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

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

x. The Contractor's Works Programme shall comply with the following;

(1) All programmes submitted in both hard copy and electronic data format.

(2) All programmes shall be prepared using the latest version of CPM scheduling software Primavera Project Planner or similar.

(3) A standard Gregorian calendar shall be used for planning and execution of the Works. All 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 non-work day it shall be effective the next working day.

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

(5) CPM programmes shall reflect status using remaining duration and percent complete.

(6) 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:

(a) Major manpower for both design and installation.

(b) Number of items of Contractor's Equipment.

(c) Number of drawings and other design deliverables.

(d) Principal quantities of components or parts.

(e) Principle quantities of bulk materials inclusive of cabling, pipe, ductwork and equipment item etc.

4.0 PMIS Requirements and Procedures

(1) Timely performance is of the essence on this project. The Contractor may complete the project or any part of the Project earlier than is stipulated in the Contract and the Milestone requirements.

(2) All design and/or construction work, including all sub-contractors' work, under this Contract shall be planned, scheduled, executed, reported and accomplished using the precedence diagramming Critical Path Method (hereinafter referred to as CPM). The work required by this section includes the requirement to prepare, maintain, and update all detailed schedules as described in this section. The CPM schedules shall be prepared in such a manner as to permit the orderly planning, organization, and execution of the Work and be sufficiently detailed to accurately depict all the work required by the Contract. The Contractor shall resource (labor and equipment) and cost load its schedule as specified herein.

(3) All schedules and schedule submittals under this Contract shall be computerized by the Contractor utilizing the latest version of ORACLE PRIMAVERA P6 PROFESSIONAL PROJECT MANAGEMENT SOFTWARE, hereinafter referred to as ORACLE PRIMAVERA P6 or any other software approved/instructed by Engineer. The Contractor shall have sufficient capabilities to perform this work and share the PMIS with the Engineer and the Employer.

(4) The Contractor shall formally transmit all schedule submittals and schedule narratives identified herein to the Engineer in the form of four (4) hard copies and one (1) soft copy on a CD at the times identified herein or at the request of the Engineer.

(5) The primary objectives of the requirements of this section are:

a) To ensure adequate planning and execution of the Works by the Contractor;

b) To assist the Engineer in evaluating progress of the Works;

c) To provide for optimum coordination by the Contractor of its trades, Sub-contractors, and suppliers, and of its work with the Works or services provided by any separate contractors;

d) To permit the timely prediction or detection of events or occurrences which may affect the timely prosecution of the Works;

e) To provide a mechanism or tool for use by the Engineer and the Contractor in determining and monitoring any actions of the Contractor which may be required in order to comply with the requirements of the Contract documents relating to the completion of the various portions of the Works by the Contract Milestones and Contract completion specified in the Contract documents.

(6) The Contractor is responsible for determining the sequence of activities, the time estimates for the detailed design and construction activities and the means, methods, techniques and procedures to be employed. The schedules identified herein shall represent the Contractor's best judgment of how it will execute the Work in compliance with the Contract requirements. The Contractor shall ensure that the schedule is current and accurate and is properly and timely monitored, updated and revised as project conditions may require and as required by the Contract documents.

(7) The Contractor shall provide the basic data relating to activities, durations, specified Contract Milestones, and sequences to the Engineer, as part of Contractor required schedule submittals. This data shall reflect the Contractor's actual plan for the project, and shall fully comply with all requirements of the Contract documents.

(8) Subject to the Engineer's agreement and unless identified elsewhere in the Contract documents, the Contractor shall determine when, where, and how it will interface with others performing work on the program and to coordinate its activities with all parties including the Employer and its consultants, suppliers and other contractors.

(9) The Contractor shall include in the interim schedule and Contract baseline schedule all interface points with others. These points shall be in the form of start milestones for deliverables due to the Contractor from others and as Finish Milestones for deliverables that Contractor must supply to others.

5.0 Scheduler Qualifications

1. The Contractor shall have within its employment or under contract, throughout the execution of the Work, such expertise in CPM scheduling and experience so as to ensure its effective and efficient performance under this Contract.

6.0 Schedule Orientation Session

(1) The Contractor shall, upon notification from the Engineer, attend a schedule orientation session relating to the schedules and reports requirements for this Contract. The schedule orientation session is designed to review in detail, the objectives of the schedules and reports requirements and the requirements. The Contractor shall arrange for its Project Manager, superintendent, and scheduler to attend the schedule orientation session.

(2) The following items shall be discussed during the schedule orientation session:

a) The procedures and requirements for the preparation of the interim schedule, contract baseline schedule, and monthly updates by Contractor;

b) How the requirements of the Contract documents will be monitored and enforced by the Engineer;

c) Long-lead items and time requirements for the Work by sub-contractors will be identified and included in the contract baseline schedule;

d) Work packages;

e) Coding and logic for the contract baseline schedule; and

f) Identification and scheduling of Shop Drawings and other submittals;

g) Listing of major project milestones;

h) Cost loading of major project summary activities.

7.0 Interim Schedule

(1) The Contractor shall submit its interim schedule, to the Engineer for review and acceptance at the Pre-Construction conference (or kick-off meeting for the Design portion of the project). The interim schedule shall indicate a detailed work plan for the first fifty six (56) days after the Commencement Date. Work beyond the first fifty six (56) days shall be in summary form. Use of the accepted interim schedule shall not exceed the first fifty six (56) days after the Commencement Date.

(2) The interim schedule detail plan shall include but not be limited to planned mobilization, sequence of early operations, submittals and procurement of materials and equipment. The interim schedule shall also include the following information as a minimum:

a) Activity identification number of the task or event;

b) Description of the task or event;

c) Duration of the task or event;

d) Earliest start and finish dates for the task or event;

e) Latest start and finish dates for the task or event;

f) Various stages of Design development and Construction completion

g) Milestones for activities given in this document and consequent critical points for interface with others.

h) Logic links to previous tasks upon which the task is dependent before it can start and to subsequent tasks which are dependent on the task to be completed before they can commence

(3) During the first fifty six (56) days following the Commencement Date, the interim schedule shall be updated regularly and submitted to the Engineer to indicate the progress of the Work, unless the contract baseline schedule is approved within fifty six (56) days of Commencement Date. Once the contract baseline schedule is accepted by the Engineer, no further updates of the interim schedule are required.

8.0 Contract Baseline Schedule

(1) Within forty-two (42) calendar days after the Commencement Date the Contractor shall complete the contract baseline schedule, which expands the accepted interim schedule, and submit it to the Engineer for review and acceptance. The contract baseline schedule submittal shall not show any progress until it is accepted by the Engineer.

(2) The Contractor shall submit to the Engineer a complementary and detailed narrative description of its plan for performing the Work with the submittal of the contract baseline schedule. The narrative description shall summarize the overall approach to design and/or construction sequencing, including, but not be limited to:

a) The anticipated lost days due to weather;

b) The equipment and personnel requirements by craft to complete a resource loaded schedule;

c) Whether it proposes the Work be performed on single, double or triple shifts;

(3) No application for payment shall be accepted until the contract baseline schedule is approved.

9.0 Acceptance of the Interim Schedule and Contract Baseline Schedule

(1) The Engineer and the Contractor shall review and discuss the interim schedule or contract baseline schedule after it has been submitted to the Engineer.

(2) After the Engineer accepts the interim schedule and contract baseline schedule, these schedules will then be used to monitor and record progress of the Work, forecast

completion dates, evaluate revisions and generate the payment application amounts, where applicable. Acceptance of the interim schedule or the contract baseline schedule by the Engineer shall not relieve the Contractor of total responsibility for the Contractor's means and methods, scheduling, sequencing, and prosecuting the Work to comply with the requirements of the Contract.

(3) The Engineer shall have the right to require the Contractor to revise and resubmit the interim schedule and the contract baseline schedule to modify any Contractor data in the schedules or any portion of the schedules that the Engineer determines to be:

a) Impracticable;
b) Based upon erroneous calculations or estimates;
c) Unreasonable;
d) Required in order to ensure proper coordination by the Contractor of the work of its Sub-contractors and with the work or services being provided by any separate contractors;
e) Necessary to avoid undue interference with plant operations or those of any utility owners or adjoining property owners;
f) Necessary to ensure completion of the Work by the Contract Milestones and Contract completion dates set forth in the Contract documents;
g) Required in order for Contractor to comply with any other requirements of the Contract documents;
h) Not in accordance with the Contractor's actual operations, unless the revision or modification will change the original scope of Works. The Contractor shall bear the expense of such revisions. If the Engineer requires such revisions, the Contractor shall revise the interim schedule or contract baseline schedule and submit it for Engineer's acceptance within seven (7) calendar days.

(4) The Engineer reserves the right to require that the Contractor to adjust, add to, or clarify any portion of the schedules that may be determined to be insufficient for monitoring of the Work after the schedules are accepted. No additional compensation shall be provided for such adjustments, additions or clarifications.

10.0 Schedule Content and Format

(1) All construction activity durations shall be given in working days. The Contractor shall develop activities for the schedules so that no single activity shown has duration longer than fourteen (14) working days, except for procurement and fabrication, delivery, submittal development and approval activities that may have longer durations.

(2) For all equipment and materials to be fabricated or supplied for the Project, the contract baseline schedule shall show a sequence of activities including:

a) Material delivery and storage;
b) Erection or installation;
c) Testing of equipment and materials.

(3) The interim schedule and contract baseline schedule shall show dependencies (or relationships) between each activity. Each activity must have a successor and predecessor, except for the project start and finish milestone. The use of date constraints shall be limited to Contract milestones and Contract completion dates only.

(4) The interim schedule and contract baseline schedule shall contain or be able to demonstrate that the following items have been addressed:

a) The Project's name;
b) The Contractor's name;
c) Revision or edition number;
d) Activities of completed work;
e) Activities relating to different areas of responsibility, such as subcontracted Work which is distinctly separated from that being done by the Contractor directly;
f) Labour resources distinguished by craft or crew requirements;
g) Equipment and material resources distinguished by equipment and material requirements;
h) Distinct and identifiable subdivisions of work such as structural slabs, beams, columns;
i) Locations of work within the contract limit lines that necessitates different times or crews to perform;
j) Outage schedules for existing utility services that will be interrupted during the performance of the Work;
k) Acquisition and installation of equipment and materials supplied and/or installed by the owner or its separate contractors;
l) Material to be stored on Site;
m) Phases;
n) Interim milestones and the Contract Completion dates.

(5) The Contractor shall be responsible for expediting the delivery of all materials and equipment to be furnished by the Contractor so that the progress of construction shall be maintained according to the currently accepted contract baseline schedule for the Works. The Contractor shall notify the Engineer in writing, and in a timely manner, whenever the Contractor anticipates that the delivery date of any material or equipment will be later than the delivery date indicated by the currently accepted contract baseline schedule.

11.0 Monthly Schedule Update

(1) An update of the accepted interim schedule or contract baseline schedule shall be submitted by the Contractor to the Engineer monthly and with the monthly application for payment. Receipt by the Engineer of the monthly schedule update will be an express condition precedent to processing each invoice.

(2) On a monthly basis, the Contractor shall arrange for its Project Manager, superintendent, and scheduler to meet at the project Site with the Engineer to review Contractor's monthly schedule update. The schedule will be marked-up to show the agreed upon progress, signed by the Contractor, and a signed copy issued to the Project Manager. The monthly schedule update shall show up-to-date and accurate progress of the Works, and shall forecast the completion date for activities in progress based on the contract baseline schedule. The monthly schedule update shall be prepared by the Contractor in consultation with all its principal sub- contractors and suppliers.

(3) The monthly schedule update shall include actual activity data for progress to date, but in the monthly schedule update, the Contractor shall not change the schedule logic, the activity relationships/dependencies, or planned activity durations and shall not add or delete activities. If the Contractor believes that any of these items should be changed, then a proposed revised baseline schedule must be submitted by the Contractor to the Engineer. Although activities shall not be added or deleted in the monthly schedule update, activities associated with Work authorizations that have been recommended for approval shall be included in the next monthly schedule update.

(4) The Contractor will be notified by the Engineer, in writing, as to acceptance, reasons for rejection, or any revisions required to the schedules. Changes to the schedules agreed upon by the Contractor and the Engineer shall be incorporated by the Contractor into the schedules within seven (7) calendar days after agreement.

(5) The monthly schedule update shall show actual activity commencement and completion dates, the actual remaining duration in workdays and physical percent complete for those activities commenced and not complete. For the stored materials, the update shall show the amount of material stored, representing the total cost of the materials delivered and properly stored. The monthly schedule update shall also show a graphic comparison of the current status and the baseline plan for each activity in the network.

(6) Each monthly schedule update shall continue to show all work activities including those already completed. These completed activities shall accurately reflect “as built” information by indicating when activities were actually started and completed.

(7) Monthly schedule updates shall also contain the following information for each activity:

a) Activity identification number, description and estimated original duration in workdays;

b) Calculated early and late finish dates;

c) Actual start and actual finish dates, and remaining duration, in calendar, for those activities started and not completed;

d) Days ahead and/or behind schedule of the milestones representing the specified Contract Milestones and Contract completion dates;

e) Physical percent complete for each activity;

f) A float analysis of the longest path through the schedule detailing potential delays and areas for acceleration. Actual start and finish dates shall be indicated for each activity as appropriate. Completed activities will be omitted from remaining float and late start slots.

12.0 Revised Baseline Schedule

(1) If the current contract baseline schedule or monthly schedule update no longer represents the actual or planned prosecution and progress of the Work, the Contractor shall submit (at no additional cost to the Employer, a proposed revision to the current contract baseline schedule in accordance with this section.

(2) If the Engineer believes that the current contract baseline schedule or monthly schedule update no longer represents the actual or planned prosecution and progress of the Work, the Engineer may require of the Contractor, and the Contractor shall submit (at

no additional cost to the Employer, a proposed revision to the current contract baseline schedule in accordance with this section.

(3) Schedule Revisions, as defined herein, shall refer to modifications made to activities in the accepted interim schedule or contract baseline schedule in any of the following items:

a) Activity duration;
b) Changes in logic connections between activities;
c) Changes in constraints;
d) Changes in value loading;
e) Changes to activity descriptions;
f) Activity additions and deletions.

(4) Any proposed revisions to the contract baseline schedule must be submitted to the Engineer for acceptance. This submittal must include, at a minimum, a written narrative with a full description and reasons for each work activity revised a full schedule printout, and a soft copy of the proposed revised contract baseline schedule. For revisions affecting the sequence of work, the Contractor shall provide a schedule diagram Fragmented Network (Fragnet) which compares the original sequence to the revised sequence of work. This diagram shall maintain the Contract Milestone and Contract completion dates.

13.0 Recovery Schedule

(1) Should the updated interim schedule, contract baseline schedule or monthly schedule update, at any time during Contractor's performance, show that the Contractor is fourteen (14) or more calendar days behind schedule for any Contract interim Milestone, substantial completion or for Contract completion, the Contractor shall prepare a recovery schedule separate from the updated and approved monthly schedule update explaining and displaying how the Contractor intends to reschedule its work in order to regain compliance with the contract baseline schedule during the immediate subsequent pay period.

(2) If a recovery schedule is required, the Contractor shall prepare and submit to the Engineer a recovery schedule, incorporating the best available information from sub-contractors and others, which will permit the forecasted completion dates to return to the interim milestones and the Contract completion dates. The Contractor shall prepare a recovery schedule to the same level of detail as the originally accepted contract baseline schedule submittal.

(3) Within seven (7) working days after submission of the recovery schedule, the Contractor shall meet with the Engineer to review and evaluate the recovery schedule. Within seven (7) working days of that meeting, the Contractor shall submit the recovery schedule, including any revisions necessitated by the review, to the Engineer for its review and acceptance. The recovery schedule, once accepted by the Engineer, shall be implemented as the revised contract baseline schedule for the remaining Work.

14.0 IT Requirement For DFC

1. DFCCIL is in the process of implementing an Enterprise wide IT System through a World Bank Funded Project titled "Supply & Installation of Integrated IT System". The objective of

the IT Plan is to automate core organizational business functions/ processes and develop a working environment that enables higher efficiency and effectiveness, not only in internal functions, but across the entire ecosystem of DFCCIL, including Contractors. A total of eight (8) applications are envisaged for DFCCIL and components of the proposed system include the following elements:

a) An ERP System for covering Finance & Accounting, HR, Project Managements, General Administration to ensure an integrated management control

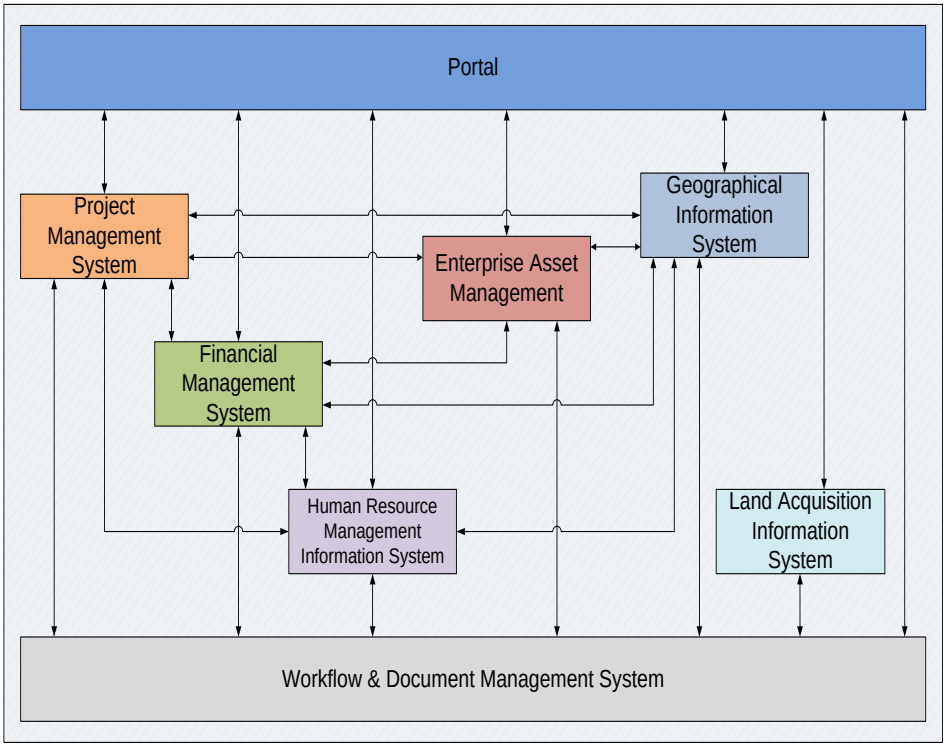
b) A Document Management System to ensure that all drawings/critical documents related to the construction phase are well documented and achieved

c) A Geographical Information System that will initially have details of every asset that is created. It will have the entire alignment geo-referenced. The monitoring of various Contracts is proposed to be done through Dashboards that will have a significant component of GIS.

d) An Enterprise Asset Management that has spatial co-ordinates of every asset

2. The proposed IT system has been designed for facilitating preservation of important artifacts (plans, drawings, notes, documents, reports etc) in a secure and manageable environment in digitized format. Appropriate triggers will generate dashboards and management reports every time an event causes a substantial shift in project risk or timeline or is a deviation in processes developed. The envisaged system would expedite decision making, ensure better planning and co-ordination between different functions, better data management, effective reporting, knowledge management, etc. Program Management will provide senior management with critical information related to various contracts, activities and funds in the form of management dashboards with inbuilt triggers to ensure timely decision making.

3. Since most of the Project related Data creation would happen outside DFCCIL core organization, the proposed IT system is largely dependent on data being created and uploaded by Contractors.



4. While DFCCIL would define the data collection templates, Contractor would upload actual data into the system. As such, a part of the Scope of Work of the Contractor will include the following elements:

   (i) Upload/definition of Project Plans as per the template and using the software defined by DFCCIL

   (ii) Maintenance and updation of uploaded Project Plans in software used by DFCCIL

   (iii) Upload of drawings/designs created by Contractor as per the classification and on the software platform defined by DFCCIL

   (iv) Online MB (Measurement Book) Entry in Project Monitoring System, in a template defined by DFCCIL.

   (v) Asset details needs to be updated in the system in format prescribed by DFCCIL.

   (vi) Geo-referencing of the alignment on WGS 84 Coordinates

   (vii) Capture and upload of geo-referencing coordinates of the assets into GIS

   (viii) Upload of digitally signed invoices for payment processing

5. It will be the responsibility of the Contractor to ensure that there is interoperability between the Contractor's IT System and that being developed by DFCCIL so that movement of information and data across the DFCCIL boundaries is feasible in a seamless manner.

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APPENDIX - 5

MONTHLY PROGRESS REPORTS

1. General

(1) The Contractor shall submit to the Engineer, a monthly progress report in accordance with the Conditions of Contract.

(2) This Report shall be submitted no later than the 7th day of each calendar month and shall account for all work actually performed during the last month.

(3) It shall be submitted in English in five hard copies and one copy in CD/DVD.

(4) It shall be submitted in a format agreed to by the Engineer and shall contain sections/sub-sections for, but not be limited to the topics listed in Clauses 2 to 10 below.

(5) The results of quality audits shall be summarized in the Contractor's monthly reports.

2. Safety

(1) A review of all safety aspects during the month including reports on all accidents and actions proposed to prevent further occurrence including details of safety training and drive conducted during the period and proposed in coming months. This shall be the first item of Monthly Progress Report.

3. Financial Status

(1) A narrative review of all significant financial matters, and actions proposed or taken in respect to any outstanding matters.

(2) A spread sheet indicating the status of all payments due and made including recoveries if any.

(3) A report of the status of any outstanding claims even if these is NIL.

(4) The report shall in particular provide interim updated accounts of continuing claims.

4. Physical Progress

(1) It shall describe the status of work performed in descriptive form, significant accomplishments, including critical items and problem areas including current and anticipated delaying factors and their impact, corrective actions taken or planned and other pertinent activities, and shall, in particular, address interface issues with all agencies involved, problems and resolutions during the period or anticipated.

(2) It shall include a simplified representation of progress measured in percentage terms compared with percentage planned as derived from the Works Programme.

5. Programme Update (For entire Project)

(1) Programme updating shall include:

a) The monthly programme update which shall be prepared by recording actual activity completion dates and percentage of activities completed up to the last day of the month and expected activity completion based on current progress.

b) The Programme update shall be accompanied by an activity report and a narrative statement.

c) The narrative statement shall explain the basis of the Contractor's submittal:

i. Early Work and baseline submittals – explains determination of activity duration and describes the Contractor's approach for meeting required Key Dates as specified in the Contract **"Employer's Requirement, Section V(A), Volume 6, Appendix 4 – Project Program Requirements"**..

ii. Updated detail programme submittals – state in the narrative the Works actually completed and reflected along critical path in terms of days ahead or behind allowable dates, specific requirements of narrative are:

- If the updated detailed work programme indicates an actual or potential delay to Contract Completion date or Key Dates, identify causes of delays and provide explanation of work affected and proposed corrective action to meet Key Dates or mitigate potential delays.
- Identification of any deviation from previous month's critical path.
- Identify by activity number and description, activities in progress and activities scheduled to be completed.
- Discuss variation work order items, Value Engineering items, if any.

d) Programme Status which shall:

- Show Works Programme status up to and including the current report period, display cumulative progress to date and a forecast of remaining work.
- Be presented as a bar-chart size A3 or A4 and as a time-related logic network diagram on an A1 media, including activity listings.

e) The activity variance analysis which shall analyse activities planned to start prior to or during the report period but not started at the end of the report period as well as activities started and/or completed in advance of the Works Programme.

6. Three-Month Rolling Programme

The three month rolling programme shall be issued on a monthly basis.

7. Planning and Co-Ordination

(1) A summary of all planning/co-ordination activities during the month and details of outstanding actions.

(2) A schedule of all submissions and consents/approvals obtained/outstanding.

8. Procurement Report

(1) A summary of all significant procurement activities during the month, including action taken to overcome problems.

(2) A report listing major items of plant and materials which will be incorporated into the Works.

(3) The items shall be segregated by type and the report should show as a minimum the following activities:

a) Purchase order date - scheduled/actual;

b) Manufacturer/supplier and origin;

c) Letter of credit issued date;

d) Manufacturer/supplier ship date - scheduled/actual;

e) Method of shipment;

f) Arrival date in India- scheduled/actual.

9. Production and Testing

(1) A review of all production and manufacturing activities during the month.

(2) Summaries of all production and manufacturing outputs during the month together with forecasts for the next month.

(3) Review of all testing activities (both at Site and at the manufacture's premises) during the month

10. Deployment of Manpower Material and Equipment at Site

(1) Detail showing the extent of deployment of manpower, equipments and stock of important construction materials utilized at the Site.

(2) A list of major construction equipment used on the Project during the reporting period and any construction equipment idle during the reporting period.

(3) A list of all major or critical materials and equipment, indicating current availability and anticipated job Site delivery dates.

(4) The total number of personnel by craft actually engaged in the work during the reporting period, defined separately as to office, supervisory, and field personnel.

(5) A manpower and equipment forecast for the upcoming twenty eight (28) days, stating the total number of personnel by craft, defined separately as to office, supervisory and field personnel.

(6) Changes or additions to Contractor's supervisory personnel that occurred from the preceding Monthly Progress Report. The Monthly Progress Report shall accompany the Application for Payment and monthly schedule update.

11. Photographs and Videography

Submission requirements for photographs and videography are defined in Clause 21.3,**Part 2 "Employer's Requirement, Section V(A) , Volume 5,Manufacturing,Supply,Installation, Testing and Commissioning**".

12. Quarterly Progress Report

Quarterly progress report will also be submitted on the similar lines.

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APPENDIX - 6

QUALITY ASSURANCE

1. General

(1) The Contractor shall implement a project quality management plan in accordance with EN ISO-9001-2001, international (ISO 9001-2000), "Quality System" - Model for Quality Assurance in Production, Installation and Servicing" to ensure that all materials, workmanship, plant and equipment supplied and work done under the Contract meets the requirements of the contract.

(2) This plan shall apply to all activities related to the quality of items, including designing, purchasing, inspecting, handling, assembling, testing, storing, and shipping of materials and equipment and different elements of construction work and installations of components.

(3) The Contractor shall, within sixty (60) days of the Commencement Date, prepare and submit to the Engineer for review his proposed Quality Assurance Plan, which shall comply with the requirements as mentioned in this **Appendix**.

2. Quality Assurance Management Plan

(1) The Project Quality Management Plan (PQMP) shall as a minimum address the quality system elements as required by EN ISO 9001-2001, generally noting the applicability to the Contractor's Works Programme for the Project.

(2) Procedures or quality plans to be prepared by others (suppliers, sub-contractors, etc) and their incorporation in the overall PQMP shall be identified.

(3) The Contractor shall provide and maintain with the Engineer a Quality Assurance (QA) plan to regulate methods, procedures, and processes to ensure compliance with the Contract requirements.

(4) The QA Plan, including QA written procedures, shall be submitted to the Engineer for his review.

(5) Adequate records shall be maintained in a readily retrievable manner to provide documented evidence of quality monitoring and accountability.

(6) These records shall be available to Engineer at all times during the term of the Contract and during the Defects Notification Period.

(7) The Plan shall identify:

a) special product realization processes that are product realization activities that control or verify quality and are performed by certified personnel in accordance with documented procedures that have the written consent of the Engineer;

b) Measuring and monitoring procedures shall provide for control and reporting of non-conformances conditions to the Engineer; Inspection shall occur at appropriate points in the installation sequence to ensure compliance with drawings, test specifications, process specifications, and quality standards while the Engineer may designate, if necessary, inspection hold points into construction, installation or inspection planning procedures;

c) Inspection on delivery procedures to preclude the use of nonconforming materials and to ensure that only correct and accepted items are used and installed;

d) Identification, tracking and inspection status system to identify and track the progressive inspection status of equipment, materials, components, construction,

subassemblies and assemblies as to their acceptance, rejection, or non-inspection shall be maintained;

e) Identification and control of items: an item identification and traceability control shall be provided;

f) Handling, storage, preservation and delivery: provide for adequate work, surveillance and inspection instructions.

(8) The QA plan shall ensure that conditions adverse to quality such as failures, malfunctions, deficiencies, deviations, and defects in materials and equipment shall be promptly identified and corrected.

(9) The QA plan shall provide for establishing, and maintaining an effective and positive system for controlling non-conforming material including procedures for the identification, segregation, and disposal of all non-conforming material while the use or repair of non-conforming materials shall require the Engineer's consent.

3. Plan Implementation and Verification

(1) The Plan shall clearly define the Quality Assurance (QA) organization. Management responsibility for the QA shall be set forth on the Contractor's policy and organization chart.

(2) The plan shall define the requirements for QA personnel, their skills and training.

(3) Records of personnel certifications shall be maintained and monitored by the QA personnel. These records shall be made available to the Engineer for review, upon request.

(4) The QA operations shall be subject to the Engineer's, Employer or his authorised representative's verification at any time.

(5) 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) The Contractor's quality audit schedule shall be submitted to the Engineer for consent every three months or more frequently as required.

(7) The results of quality audits shall be summarized in the Contractor's monthly reports.

(8) The Contractor shall provide all necessary access, assistance and facilities to enable the Engineer to carry out on-Site and off-Site surveillance of QA audits to verify that the quality system which has the consent of the Engineer is being implemented fully and properly.

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APPENDIX - 7

DRAWING AND CAD STANDARDS

1.0 Introduction

(1) The purpose of this document is to define the minimum Drawing and CAD standard to be achieved by the Contractor for all drawings produced by the Contractor for the purpose of the Works.

(2) By defining a common format for the presentations of Drawings and CAD files, the exchange of drawn information is improved and will maximise the use of CAD in the co-ordination process.

(3) All submissions shall be made to the Employer's requirement in a format reviewed without objection by the Engineer in accordance with the requirements in the Contract;

(4) Paper and drawing sizes shall be "A" series sheets as specified in ISO 5457.

(5) The following software compatible for use with Intel-Windows based computers shall be used, unless otherwise stated, for the various electronic submissions required:

Document Type	Electronic Document Format
AutoCAD Graphics	CorelDraw, Ver. 12.0/ AutoCAD 2011 or latest versions
Photographic	Adobe Photoshop CS2 or last version
Desktop Publishing	Page Maker 7.0 or latest version
CAD Drawings	AutoCAD 2011 or latest version.

(6) For electronic file submission one copy shall be submitted unless otherwise stated on CD-ROM media. The media shall be CD-R and the recording method shall not allow any further changes to the recordable disk.

(7) Internet File Formats/Standards:

(a) The following guidelines shall be followed when the Contractor uses an internet browser as the communication media to share information with the Engineer /Employer.

(b) All the data formats or standards must be supported by Microsoft Internet Explorer version 7 or above running on Windows XP or above.

(c) The following lists the file types and the corresponding data formats to be used on internet. The Contractor shall comply with them unless prior consent is obtained from the Engineer for a different data format:

File Type	**Data Format**
Photo Image	Joint Photographic Experts Group (JPEG)
Image other than Photo	GIF or JPEG

Computer Aid Design files (CAD)	Computer Graphics Metafile (CGM) and DWG
Video	Window video (.avi)
Sound	Wave file (.wav)

(8) The following states the standards to be used on the internet when connecting to database(s). The Contractor shall comply with them unless prior consent is obtained from the Engineer for a different standard:

Function to be implemented	Standard to be complied with
Database connectivity	Open Database Connectivity (ODBC)
Publishing hypertext language on the World Wide Web	Hypertext Markup Language (HTML)

2.0 GENERAL REQUIREMENTS

2.1 General

(1) The Contractor shall adopt a title block similar to that used in the drawings for all the Contractor's documents prepared under the Contract.

(2) Each document shall be uniquely referenced by a document number and shall define both the current status and revision of the drawing.

(3) The current status of each document shall be clearly defined by the use of a single letter code as follows:

(a) A single letter character denoting the status of the drawings e.g.

T Tender Design
W Working Drawing
M Manufacturing Drawing
S Site Drawing
D Shop Drawing
A As Built Drawing

(b) A single digit code denoting the contract number (for the whole line)

1 Design
2 Civil / Track Works from XXX to XXX.
3 Electrification Works
4 Signalling works
5 Telecommunication Works

(c) A two (2) letter code denoting the type of civil works or system elements e.g.

CG General Works
ST Stations
TU Tunnels (if any)
AL Alignment
RW Right - Of - Way

CE	Civil Engineering (earth work, culverts, pedestrians, foot bridge, agricultural underpass, survey, track drainage, etc.)
RB	Railway Bridges
ROB	Road over Bridges
RUB	Road under Bridges
EC	Environmental Control System
UT	Utilities (Power, Gas, Telecoms, Electric, Water supply, Sewer lines)
SE	Structural Engineering (structural steel, reinforced concrete etc.)
GE	Geotechnical Engineering (Instrumentation, ground treatment, de-watering, etc.)
AR	Architecture
LS	Landscape
EE	Electrical Engineering (low voltage)
ME	Mechanical Engineering (ventilation, fire fighting, plumbing)
PS	Power Supply (high voltage, traction power)
SG	Signalling (train control)
CM	Telecommunications, TK Track-work
TM	Traffic Management (Roads, Pavements)
WS	Water Supply
SW	Switching Stations
GS	Grid Sub-stations
TS	Traction Sub-stations
TL	Transmission Line
SC	SCADA

(d) A unique four (4) digit number (from 0001 to 9999), identifying each drawing.

(e) A single letter (A to Z except I and O) denoting the sequence of revision to the drawing. The initial drawing issue will carry a revision letter "A".

Example: Drawing Title Block:

Status	Drawing No:	Revision:
D	1 / ST / 0235	B

(Note: The comparable computer reference is “1ST0235B”)

Denotes:

(D) Shop Drawing (1) Design(ST) Stations (0235B) Drawing number 0235 Rev. B

2.2 Types of Drawings

(1) 'Working drawings' are those as defined in Volume 2 Section V, Part 2 of Bid Documents.

(2) Site drawings and sketches’ are drawings, often in sketch form, prepared on Site to describe modifications of the Working Drawings where Site conditions warrant changes that do not invalidate the design.

(3) 'Shop drawings' are special drawings prepared by the manufacturer or fabricator of various items within the Works to facilitate manufacture or fabrication.

(4) 'Reference Drawings' are those as defined in Volume 2 Section V, Part 2 of Bid Documents.

(5) 'As-built drawings' are those as defined in Volume 2 Section V, Part 2 of Bidding Documents. These drawings shall be completed on a regular basis as the Works progress, and shall not be left until completion of the entire Works.

3.0 COMPUTER AIDED DESIGN AND DRAWING (CAD) STANDARDS

3.1 Introduction

(1) The production of all CAD data files shall comply with the applicable legislation in India, standards for the relevant issue and the requirements as defined hereinafter.

3.2 Objectives

(1) The main objectives of the CAD standards are as follows:

(a) To ensure that the CAD data files produced for project are co-ordinated and referenced in a consistent manner.

(b) To provide the information and procedures necessary for a CAD user from one discipline or external organisation to access (and use as background reference), information from a CAD data file prepared by another discipline or external organisation.

(c) To standardise the information contained within CAD data files which may be common to more than one discipline such as drawing borders, title boxes, grid lines etc.

(d) To establish procedures necessary for the management of CAD data files.

(e) To ensure all contractors use 'Model space' and 'Paper space' in the production of their CAD files.

3.3 General

(1) To facilitate co-ordination between contractors, it is a requirement that all drawings issued by contractors for co-ordination or record purposes shall be produced using CAD methods.

(2) The intent of the issue of digital information is to aid the interface design by others.

(3) The definitive version of all Drawings shall always be the paper or polyester film copies which have been issued by the Contractor or organisation originating the drawing and also held in the Project's electronic document control system.

(4) Drawings and drawing packages issued for co-ordination, record purposes or for acceptance shall be accompanied by a complete set of the corresponding CAD data files.

(5) Any contractor or organisation making use of the CAD data from others shall be responsible for satisfying him that such data is producing an accurate representation of the information on the corresponding paper drawing which is satisfactory for the purpose for which he is using it, provided the general principles of this section have been achieved by the originator of the CAD data, contractors making use of the CAD data from others shall not be entitled to require alterations in the manner in which such CAD data is being presented to them.

(6) In particular, automatic determination of physical dimensions from the data file shall always be verified against the figured dimensions on the paper or polyester drawings.

(7) Figured dimensions shall always be taken as correct where discrepancies occur.

3.4 Terminology and Associated Standards

(1) Any terminology used within this section that is ambiguous to the user shall be clarified with the Engineer. Indian national and Indian Railways standards are to be used in principle as a guide for drawing practice, convention, CAD data structure and translation.

3.5 Paper Drawings

(1) For the Project "Paper" drawings are considered to be the main vehicle for the receipt and transmittal of design and production information, typically plans, elevations and sections.

3.6 CAD Quality Control

(1) Random CAD Quality control audits will be carried out by Engineer on all CAD media received and transmitted.

(2) These checks DO NOT verify the technical content of the CAD data received or transmitted (as this is the responsibility of the originating organisation); however compliance with project CAD and Drawing Standards shall be checked.

(3) In addition, all contractors who transmit and receive CAD data from the Project shall have CAD quality control procedures in place.

(4) A typical quality control procedure shall contain CAD data quality checking routines coupled with standards for CAD data transmittal and archiving.

3.7 CAD Data Transfer Media and Format

(1) When CAD data is received and transmittal between the Engineer and the Contractor, the media shall be as follows:

(a) All CD-R/RW and DVD+/-R must be labeled on the data shield with:

i. Name of Company

ii. Project Title

iii. Drawing Filenames

iv. Disk No. / Total No. of disks

(b) All media shall be submitted with a completed form (CAD Disk)

(c) The CAD data file transmittal format required by from all contractors shall be in AutoCAD (version 2011) or latest version.

3.8 Revisions

(1) All 'Revisions', 'In abeyance' and 'Deletions' shall be located on a common layer which can be turned on or off for plotting purposes.

3.9 Block Libraries, Blocks and Names

(1) All construction industry symbols produced as CAD Cells shall typically conform to Indian Standards.

(2) All blocks created shall be primitive (i.e. NOT complex) and shall be placed absolute (i.e. NOT relative).

(3) The Contractor's specific block libraries shall be transmitted to Engineer together with an associated block library list containing the filename (max. 6 characters) and block description.

(4) The Contractor shall ensure that the library is regularly updated and circulated to all other users, together with the associated library listing.

(5) All blocks of a common type, symbols or details should initially be created within a CAD "Model Space File" specifically utilised for that purpose. These files will be made available on request by Engineer.

(6) All blocks created will typically be 2D unless 3D is specifically requested. In both instances they shall have an origin at a logical point located within the extents of each block's masked area or volume.

3.10 CAD Dimensioning

(1) Automatic CAD Dimensioning will be used at all times.

(2) Any dimensional change must involve the necessary revision to the model space file.

(3) If the CAD Quality Control Checks find that the revisions have not been correctly carried out, the rejection of the entire CAD submission will result.

3.11 CAD Layering

(1) All CAD elements shall be placed on the layers allocated for each different discipline.

(2) The Contractor's layer naming convention shall be submitted for the Engineer's approval.

3.12 Global Origin, Location and Orientation on the Alignment Drawings

(1) Location or plan information in "Model Space" files shall coincide with the correct location and orientation on the project grid for each specific contract.

(2) Location plans shall have at least three setting out points shown on each CAD "Model Space" file. Each setting out point shall be indicated by a simple cross-hair together with related Eastings and Northings co-ordinates.

(3) The civil, structures and track Contractor(s) will establish the three setting out co-ordinates for their respective works, which will then be used by all other contractors including the Contractor.

3.13 Line Thickness and Colour

(1) To assist plotting by other users, the following colour codes will be assigned to the following line thickness / pen sizes:

Colour	Code No.	Line Thickness
Red	**10**	**0.18**
Yellow	**2**	**0.35**
Brown	**34**	**0.5**
Blue	**130**	**0.7**

Orange	**30**	**1.0**
Green	**3**	**1.4**
Grey	**253**	**2.0**

3.14 CAD Utilisation of 2D and 3D Files

Although the project standard is 2D CAD files, certain disciplines and contractors may use 3D CAD files for specific applications or where the isolated use of 3D aids the design and visualization process (i.e. architecture, survey and utilities).

3.15 CAD File Numbering

Contractor's CAD file numbering shall be as described in clause 2.1 above.

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APPENDIX - 8

TEMPORARY POWER SUPPLY

1 Introduction

The standard conditions applying to temporary power supply to any Works Area by the Contractor for its Site facilities are given under Clause 2 of this **Appendix**.

2 General

(1) The Contractor shall nominate a qualified electrical supervisor, whose name and qualifications shall be submitted in writing to the Engineer for review, who shall be solely responsible for ensuring the safety of all temporary electrical equipment on Site.

(2) The Contractor shall not install or operate any temporary electrical systems on the Site until this electrical engineer is appointed and has commenced duty.

(3) The name and contact telephone number of the qualified electrical engineer shall be displayed at the main distribution board for the temporary electrical supply so that he can be contacted in case of an emergency.

(4) The Contractor shall submit all base electrical circuits, characteristics and the details of the equipment for all temporary electrical installations, together with details of the temporary electrical equipment shall be submitted to the Engineer for his consent.

(5) All electrical installation work on Site shall be carried out in accordance with the requirements laid down in the Performance Specification and Indian standards.

(6) All work shall be supervised or executed by qualified engineers or suitably skilled and authorised electricians.

(7) Temporary electrical Site installations and distribution systems shall be in accordance with the rules and regulation applicable for and/or applied by:

a) The local electrical company supply rules;

b) Wiring regulations;

c) Distribution of electricity on construction and building sites;

d) Distribution assemblies for electricity supplies for construction and building sites;

e) Regulations for fire safety norms and requirements for civil works; and

f) Any other applicable Indian standards and regulations.

2.1 Materials, Appliances and Components

(1) All materials, appliances and components used within the distribution system shall comply with Indian standards.

2.2 Design Considerations

(1) Distribution equipment utilized within the temporary electrical distribution system shall incorporate the following features:

a) flexibility in application for repeated use;

b) suitability for transport and storage;

c) robust construction to resist moisture and damage; and

d) safety in use.

(2) All cabling shall be run at high level whenever possible and be firmly secured to ensure it does not present a hazard or obstruction to people and equipment.

2.3 Mains Voltage

(1) The Site mains voltage shall be as per the 400V/ 3 phases 4-wire system 50 Hz.

a) Single phase voltage shall be as per the 220V/240V supply.

b) Reduced voltages shall conform to Indian Standards.

(2) The following voltages shall be adopted for typical applications throughout the distribution systems:

a) Fixed plant – 400V/ 3 phase;

b) Movable plant fed by trailing cable – 400V /3 phase;

c) Installations in Site buildings - 220V/240V /1 phase;

d) Fixed flood lighting - 220V/240V 1 phase;

e) Portable and hand held tools – 12V, 24V or 36V /1 phase;

f) Site lighting (other than flood lighting) – 12V, 24V or 36V /1 phase; and

g) Portable hand-lamps (general use) – 12V, 24V or 36V /1 phase.

(3) When the low voltage supply is energised via the Indian Railway's power supply, any power utilised from that source shall be either 400V 3 phase or 220V/240V single phase as appropriate and the Contractor shall carry out any conversion that may be necessary to enable him to use power from that source.

(4) Protection of Circuits

a) Protection shall be provided for all main and sub-circuits against excess current, under and over voltage, residual current and earth faults.

b) The protective devices shall be capable of interrupting (without damage to any equipment or the mains or sub-circuits) any short circuit current that may occur.

c) Discrimination between circuit breakers, circuit breakers and fuses shall be in accordance with the Indian Standards.

2.4 Earthing

(1) Earthing and bonding shall be provided for all electrical installations and equipment to prevent the possibility of dangerous voltage rises and to ensure that faults are rapidly cleared by installed circuit protection.

(2) Earthing systems shall conform to the following standards:

a) Wiring regulations;

b) Guide for safety in AC substation grounding.

2.5 Plugs, Socket Outlets and Couplers

(1) Low voltage plugs, sockets and couplers, as well as the high voltage couplers and 'T' connections shall be colour coded in accordance with, and conform to Indian Standards.

2.6 Cables

(1) Cables shall be selected after full consideration of the conditions to which they will be exposed and the duties for which they are required.

(2) Supply cables shall be in accordance with Indian Standards.

(3) For supplies to mobile or transportable equipment where operation of the equipment subjects the cable to flexing, the cable shall conform to Indian Standards, as well as one of the following specifications appropriate to the duties imposed on it:

a) flexible cables for use at mines and quarries;

b) rubber insulated cables for electric power and lighting; and

c) insulated flexible cords and cables.

(4) Where low voltage cables are to be used, reference shall be made to Indian Standards, the following specifications shall also be referred to particularly for underground cables:

a) for armoured PVC insulated cables; and

b) flexible cables for use at mines and quarries.

(5) All cables which have a voltage to earth exceeding 65V (except for supplies from welding transformers to welding electrodes) shall be metal sheathed and/or armoured which shall be continuous and effectively earthed. In the case of flexible or trailing cables, such earthed metal sheath and/or armour shall be in addition to the earth core in the cable and shall not be used as the sole earth conductor.

(6) Armoured cables having an over-sheath of polyvinyl chloride (PVC) or oil resisting and flame retardant compound shall be used whenever there is a risk of mechanical damage occurring.

(7) For resistance to the effects of sunlight, overall non-metallic covering of cables shall be black in colour.

(8) Cables with an applied voltage to earth exceeding 12V but not normally exceeding 65V shall be insulated and sheathed with a general purpose or heat resisting elastomer.

(9) All cables that are likely to be frequently moved in normal use shall be flexible cables.Flexible cables shall be in accordance with Indian Standards.

2.7 Lighting Installation

(1) Where Site works are required during the night, the lighting circuits shall be run separate from other sub-circuits and shall be in accordance with Indian Standards.

(2) Voltage shall not exceed 55V to earth except when the supply is to a fixed point and where the lighting fixture is fixed in position.

(3) Luminaries shall have a degree of protection not less than IP 54.

(4) In particularly onerous environments where the luminaries are exposed to excesses of dust and water, a degree of protection to IP 65 shall be employed.

(5) The Contractor shall provide a minimum lighting level of 200 lux by localised lighting in all areas where required for carrying out the works.

(6) Wherever a risk of damage may occur, luminaries shall be mechanically protected against impact damage by use of wire guards or other such devices.

2.8 Electric Motors

(1) Totally enclosed fan cooled motors to Indian Standards shall be used.

(2) Motor control and protection circuits shall be as stipulated in Indian Standards.

(3) Emergency stop switches shall be provided for all machinery.

2.9 Inspection And Testing

(1) Electrical installations on Site shall be inspected and tested in accordance with the requirements of the wiring regulations.

2.10 Identification

(1) Identification labels shall be affixed to all electrical switches, circuit breakers and motors to specify their purpose.

2.11 Maintenance

(1) Regular maintenance and checking of control apparatus and wiring distribution systems shall be carried out by a engineer or electrician (duly qualified to carry out the said checks) to ensure safe and efficient operation of the systems.

(2) All portable electrical appliances shall be permanently numbered (scarf tag labels or similar) and a record kept of the date of issue, date of the last inspection and the recommended inspection period.

2.12 Metering

(1) The Contractor shall install and register a separately electrometer for each supplies of electricity from the applicable suppliers. The Contractor shall pay all required charges for the supplied electric power.

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APPENDIX - 9

PROJECT CALENDAR

1. THE PROJECT CALENDAR

(1) The Project Weeks shall be commenced on a Monday.

(2) A day shall be deemed to commence at 00:01 hour on the morning of the day in question.

(3) Where reference is made to the completion of an activity or Milestone by a particular week, this shall mean by midnight on the Sunday of that week.

(4) Requirements for the computation of Key Dates are given in Paragraph 3, **Part 2 "Employer's Requirement, Section V(A) , Volume 6,Appendix 2 – Work Areas and Contract Stages"**.

(5) A 7 day week calendar shall be adopted for various (Work) programme schedules for scheduling purposes, which shall also display the rest day and holidays.

(6) For Project purposes, the presentation shall be in 'Week"' units.

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APPENDIX 10

FIRST AID BASE

1. FIRST AID BASE

(1) First aid bases shall be located at each of the Contractor's principal Works Areaand shall be made functional in all respect before commencement of physical work.

(2) The base shall consist of a treatment room fitted with two treatment couches, a hand wash basin, sterilising equipment and lockable cupboards to contain sufficient medical supplies for the Contractor's personnel, the Employer's personnel, the Engineer's personnel and the interfacing contractor working in the area and any visitors to the Site.

(3) In addition, two stretchers shall be stored, available for instant use.

(4) The first aid base shall contain a recovery room that shall be furnished with six chairs and a centre table.

2. STAFFING

(1) A qualified doctor shall be available on call during all times when work is being undertaken on Site.

(2) In each Site office and location at least one employee of the Contractor shall be trained in first aid and shall be available during all working hours for the purpose of attending to emergencies.

(3) The Contractor may conclude a contract with the local health centre where they are unable to implement any of the above services

3. EQUIPMENT

(1) A fully equipped ambulance and driver shall be available on call during all working hours.

(2) The ambulance shall be equipped with emergency life support equipment suitable for application in construction Site accidents.

(3) Portable first aid boxes will be maintained fully equipped at each of local Site offices.

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APPENDIX - 11

DESIGN CERTIFICATE

This Design Certificate refers to Submission No. …… which comprises:

[*Design Package No..... / the Definitive Design and Drawing Submission No..... / Technical Submission No. ....] in respect of :

[description of the Works to which the submission refers]

The contents of this submission are scheduled in Section A below.

The documents scheduled in Section B below, for which a Notice of No Objection has been issued, are of relevance to this submission.

DESIGNER'S STATEMENT

We hereby certify that :

a) the design of the Works, as illustrated and described in the documents scheduled in Section A below, complies with the specifications requirements and ..... [*see note 1 below*];

b) the outline designs, design briefs and performance specifications of those elements of the Works as illustrated and described in the documents scheduled in Section A below comply with the specifications requirements and ..... *[see note 1 below]*;

c) the design of the Works, as illustrated and described in the documents scheduled in Section A below, complies with the Employer's Requirements specifications requirements and ..... *[see note 1 below]* except in the following respects:

   (i) ..... (to be completed by Contractor/Designer)

   (ii) ..... (etc.)

d) an in-house check has been undertaken and completed to confirm the completeness, adequacy and validity of the design of the Works as illustrated and described in the documents scheduled in Section A below;

e) all necessary and required approvals relating to the design of the Works, as illustrated and described in the documents scheduled in Section A below, have been obtained and copies of such approvals are annexed in Section C below;

AND (in the case of a submission covering a part of the Works only) :

f) all effects of the design comprising the submission on the design of adjacent or other parts of the Works have been fully taken into account in the design of those parts.

Signed by 'Authorised Representative'

(for Designer)

Name

Position/ Designation

Date

CONTRACTOR'S CERTIFICATION

This is to certify that all design has been performed utilising 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 'Authorised Representative' (for Contractor)

Name

Position/Designation

Date

Note 1

The Contractor shall insert one of the following, as applicable:

(i) the Contractor's Technical Proposals

(ii) the Contractor's Technical Proposals and Design Packages Nos. ..... for which a Notice of No Objection has been issued.

(iii) Design Packages Nos. ..... for which a Notice of No Objection has been issued if such Design Packages develop and amplify the Contractor's Technical Proposals.

(iv) The Definitive Design

Section A

Submission no. .... comprises the following :

Drawings :*(Title, drawing number and revision)*

Documents: *(Title, reference number and revision)*

Others:

Section B

Documents for which a Notice of No Objection has been issued and which are of relevance to this Submission No. .....

Document:

Submitted with

[*Design Package No. ...../

Definitive Design Submission No……/

Good for Construction Drawing Submission No. ..../

Technical Submission No. ...../

Date of Issue of Notice of No Objection

The Contractor is required to provide this information in respect of each document in Section B

(Delete as appropriate)*

Section C

[Contractor to attach copies of necessary and required approvals]

APPENDIX - 12

SITE SAFETY PLAN

1. GENERAL

(1) The Contractor shall, within sixty (60) days of the Commencement Date, prepare and submit to the Engineer for review his proposed safety plan, as part of the Contractor's Safety, Health and Environment Plan, which shall contain as a minimum 2 to 15 items as mentioned in this **Appendix**.

(2) Procedures for updating the site safety plan and associated assurance system shall be given.

(3) The compensation for affected workers or their relatives shall be paid by the Contractor in such cases utmost expeditiously in accordance with the Workmen's Compensation Act.

2. STATEMENT OF THE CONTRACTOR'S SAFETY POLICY

(1) The Contractor shall produce a policy statement signed by the managing director of the Contractor or other senior officer acceptable to the Engineer, or the managing directors or other senior officers acceptable to the Engineer of each company of the consortium, partnership or joint venture comprising the Contractor, declaring that the Contractor shall ensure that safety and industrial health are given priority consideration in all aspects of the Works and by the Contractor in discharging his contractual obligations;

(2) An understanding of and means of ensuring due compliance with the statutory regulations and standards relating to construction work in India;

(3) The statutory and contractual obligations regarding safety, rescue and industrial health imposed on the Contractor; and the means by which the Contractor will supervise, monitor and audit his site safety assurance system to ensure due compliance with these obligations.

3. APPOINTMENT, DUTIES AND RESPONSIBILITIES OF SAFETY STAFF

(1) The safety staff and organisational structure, which should identify the personnel to be engaged solely for site safety assurance, the responsibilities of the participants and the subdivision of the site safety assurance tasks into elements which can be effectively controlled, technically and managerially.

(2) Names, addresses, telephone and facsimile numbers of all participants shall be listed where known (supplements to the site safety plan will update and complete this information);

(3) The powers vested in the safety staff, which shall be sufficient to enable them to take urgent and appropriate action to make safe the site and prevent unsafe working practices or other infringements of the safety plan or statutory regulations;

4. POLICY FOR IDENTIFYING HAZARDS

(1) The means by which the Contractor will identify hazards, assess the risks and develop procedures and method statements to minimise the risk for those risks which will occur during the works;

(2) The aspects of the Temporary Works design which should be communicated to the Engineer and others directly or indirectly associated with the Works if the installation of the associated works has a particular significance on the site safety of the Works;

(3) The Contractor shall produce a list of safety and health hazards identified for this Contract and the procedures and method statements for achieving effective and efficient minimisation of the risks associated with such hazards;

5. SAFETY EQUIPMENT

The means by which safety equipment, scaffolds, guard-rails, working platforms, hoists, ladders and other means of access, lifting, lighting, signing and guarding equipment shall be inspected, tested and maintained and the standards below which such items will be removed from the site and replaced shall be elaborated.

6. CONTRACTOR'S EQUIPMENT

(1) The Contractor shall produce policy and procedures for ensuring that all his plant and equipment used on the works site is maintained in a safe condition and is operated in a safe manner;

(2) Also regulations and procedures covering all safety and health aspects of the Works, including where appropriate but not limited to the following shall be produced by the Contractor:

a) housekeeping
b) working on or near operating railways
c) fire prevention precautions and firefighting equipment
d) working in confined spaces
e) excavation
f) hot weather working
g) electrical equipment
h) welding/cutting operations and equipment
i) personal protection clothing and equipment
j) cranes
k) hoists
l) other lifting appliances
m) manual lifting
n) ladders
o) power tools
p) hand tools and portable power driven tools
q) hazardous substances
r) working at height
s) structural steel erection
t) lighting
u) protection against falling objects;

7. SUB-CONTRACTORS

(1) The means by which safety, rescue and industrial health matters and requirements will be communicated to sub-Contractors of all tiers and their due compliance with the site safety plan and all relevant statutory regulations is ensured by the main Contractor.

(2) The method by which the safety procedures and practices proposed by sub-Contractors will be reviewed for compliance with the site safety plan and statutory regulations including the provision of hazard and risk assessments and method statements.

8. DISCIPLINARY PROCEDURES

(1) The Contractor's disciplinary procedures with respect to dealing with safety related matters both with his own staff and that of sub-Contractors shall be given.

9. ACCIDENT REPORTING

(1) The Contractor's procedure for reporting and investigating accidents, dangerous occurrences or occupational illness;

10. SAFETY PROMOTION

(1) The Contractor shall provide details of the frequency, coverage and intent of site safety meetings together with the rationale for attendance.

11. SITE SECURITY

(1) The Contractor's system for the protection of authorised and unauthorised visitors to the site;

(2) The Contractor's proposals to ensure that construction methods do not compromise the Contractor's commitment to the site safety plan or its compliance with the statutory regulations.

13. LABOUR SAFETY

(1) The activities of Contractor shall be co-ordinated with Indian Railways so as to ensure safety of all Contractor's personnel.

(2) Labour safety arrangements by the Contractor shall be in accordance with the applicable legislation in India.

(3) The design and construction shall comply with the applicable legislation in India.

(4) The Contractor shall provide the equipment needed for the labour safety during the operation of the line.

14. LEGISLATION AND CODES OF PRACTICE

(1) The Contractor shall comply with all safety and industrial health legislation including, without limitation, the rules and regulation of the National Safety Council of India.

(2) The Contractor shall keep on the site copies of safety and industrial health regulations and documents.

(3) All regulations and documents referred in this clause shall be translated into languages which are understood by the operators and supervisors engaged by the Contractor or sub-Contractors and such translations shall be displayed or kept alongside those in English language.

15. SITE SAFETY PLAN

The brief outline of site safety plan shall cover the following:

15.1 Safety Personnel

(1) The Contractor shall appoint a safety officer whose duties throughout the period of the Contract shall be entirely connected with the safety and industrial health aspects of the Contractor's activities on the site.

(2) The safety officer shall be a suitably qualified and experienced person who shall supervise and monitor compliance with the site safety plan.

(3) The safety officer shall, in particular but without limitation, carry out auditing of the operation of the site safety plan in accordance with a rolling programme to be submitted, from time to time, to the Engineer for his consent.

(4) The safety officer's appointment shall be within fifty six (56) days of the Commencement Date and shall be subject to the Engineer's written consent.

(5) The Contractor shall not undertake any works on the site until the safety officer has commenced duties at site and unless the Engineer has specifically consented in writing.

(6) The Contractor shall not remove the safety officer from the site without the express permission of the Engineer. Within fourteen (14) days of any such removal or notice of intent of removal, the Contractor shall nominate a replacement safety officer for the Engineer's consent.

(7) The Contractor shall provide the safety officer with supporting staff in accordance with the staffing levels set out in the site safety plan.

(8) The supporting staff shall include at least one Deputy safety officer whose appointment(s) shall be subject to the Engineer's consent.

(9) The Deputy safety officer(s) shall be capable of assuming the duties and functions of the safety officer as contained in the site safety plan whenever necessary.

(10) The Contractor shall ensure that the safety officer maintains a daily site safety diary, such diary comprehensively recording all relevant matters concerning site safety, safety inspections and audits, safety related incidents and the like.

(11) The site safety diary shall be reviewed and signed on a weekly basis by the Contractor’s site representative and shall be available at all times for inspection by the Engineer.

(12) The Contractor's staff organisation plan shall show direct lines of communication and reporting between the safety officer and the Contractor’s site representative and between the safety officer and the person responsible for the Contract.

(13) The Contractor shall instruct and require the Contractor’s site representative and the person responsible to be directly accountable in all matters concerning site safety.

15.2 Site Safety Inspections

(1) The Contractor will conduct site safety inspections at a regular frequency.

(2) The findings of the inspections shall be recorded on suitable forms which shall be kept available for inspection by the Engineer.

15.3 Safety / Accident Reporting

(1) The Contractor shall submit regular site safety reports to the Engineer in accordance with the site safety plan.

(2) Such reports shall be submitted as part of the Monthly Progress Report. Prior to submission, the site safety report shall be endorsed by the Project Director responsible for the Contract and the Contractor's site representative.

(3) Site safety reports shall comprehensively address all relevant aspects of site safety and industrial health regulation and, in particular, report on all site safety audits undertaken during the period covered by the report.

(4) The Engineer shall be notified by the Contractor immediately of occurrence of any accidents whether on-site or off-site in which the Contractor, its personnel or plant, or those of its sub-Contractors are directly or indirectly involved and which results in any injuries to any persons, loss / damage to plant and machinery, disruption of traffic etc.

(5) Such initial notification may be verbal and shall be followed by a written comprehensive report within 24 hours of the accident.

(6) Additionally the Contractor shall notify the Engineer in writing within twenty four (24) hours of any incident occurring whether on-site or off-site at which the Contractor or any sub-Contractors are involved and could have resulted in serious injuries to persons or significant damage to the Works. Failure to report such incidences shall be considered as a serious breach of Safety Procedures.

15.4 Sub-Contractors

(1) The Contractor shall provide its sub-Contractors with copies of the site safety plan and shall incorporate into all sub-contract documentation provisions to ensure the compliance with such plan at all tiers of the sub-contracting.

(2) The Contractor shall, with the Engineer's consent in writing, shall instruct all sub-Contractors to appoint a safety representative who shall be available on the site throughout the operational period of the respective sub-contract.

(3) These safety representatives shall ensure that all employees of sub-Contractors working at site are conversant with appropriate sections of the site safety plan and the statutory regulation.

15.5 Safety Meetings

(1) The Contractor shall convene regular safety meetings in accordance with the safety plan and shall ensure attendance by the safety officer and safety representatives of sub-Contractors unless otherwise agreed by the Engineer.

(2) All safety meetings shall be notified in advance to the Engineer who may attend in person or by representative at his discretion.

(3) The minutes of all safety meetings shall be taken and sent to the Engineer within seven (7) days of the meeting.

(4) A site safety management committee may be established by the Engineer to monitor the implementation of the safety plan and for the purposes set out in the project safety manual.

(5) The Engineer or his representative will be the Chairman of this committee and the members shall include the Contractor's agent or representative, safety manager and safety officers, sub-Contractors' safety personnel.

15.6 Safety Equipment

(1) The Contractor shall identify the safety equipment, rescue apparatus and protective clothing which will be required for the Works.

(2) The identification shall include the quantity, sourcing, standards of manufacture, storage provisions and means of ensuring proper utilisation by all workmen and staff employed directly or indirectly by the Contractor and repair to or replacement of damaged equipment.

(3) The Contractor shall ensure that safety equipment and protective clothing as described in the safety plan is available and used on the site at all material times and those measures for the effective enforcement of proper utilisation and necessary replacement of such equipment and clothing is incorporated into the site safety plan. Such equipment shall include, but not be limited to: site helmets, goggles and other eye protectors, hearing protectors, safety harnesses, safety equipment for working in confined spaces (e.g. sewers, drains etc.), rescue equipment, equipment to rescue persons from drowning (if applicable), fire extinguishers, first aid equipment, and, where appropriate, suitable fall arrest equipment.

(4) The Contractor shall regularly inspect, test and maintain all safety equipment, scaffolds, guard-rails, working platforms, hoists, ladders and other means of access and egress, lifting, lighting, signage and guarding equipment.

(5) Lights and signs shall be kept clear of obstructions and legible to read.

(6) Equipment which is damaged, dirty, incorrectly positioned or not in working order shall be repaired or replaced immediately.

15.7 First Aid

(1) The Contractor shall establish, maintain, staff, and fully equip a first aid base as detailed in **Part 2 "Employer's Requirement, Section V(A), Volume 6, Appendix 10 – First Aid Base"**.

15.8 Site Publicity

(1) The Contractor shall ensure that safety, rescue and industrial health matters are given a high degree of publicity to all persons regularly or occasionally on the site.

(2) Posters, in both Hindi and English, drawing attention to site safety, rescue and industrial health regulation shall be made or obtained from the appropriate sources and shall be displayed prominently in relevant areas of the site.

(3) These posters shall be changed on a monthly basis in order to ensure their continued impact.

(4) All personnel whether permanent, temporary or visitors will be given a site safety induction before they are allowed on to the site.

15.9 Training

(1) The Contractor shall conduct regular safety training and rescue training drills, the frequency, coverage and application of which shall be in accordance with the site safety plan, and in any case shall not be more than every six months. Engineer may monitor the content of such training programs.

(2) The Contractor shall require that all sub-Contractors' employees participate in relevant training courses appropriate to the nature, scale and duration of the sub-contract works.

(3) The Contractor shall produce a description of the safety training courses that are to be provided. The syllabus, frequency, coverage and application of training courses shall be included together with the means of attaining the objective that all workmen shall be required to attend a safety induction course within their first week on site and thereafter at times appropriate to their prospective duties and at intervals of not more than six months. A summary of such training program conducted/ planned shall form part of Monthly Progress Report.

15.10 Breach of Safety Regulations

(1) Any employees of the Contractor or sub-Contractor of any tiers who commit a serious breach of the safety regulations shall be liable to summary dismissal and shall not be re-employed on the Contract or allowed on any of the sites.

(2) The due notice of this sanction shall be prominently displayed on the site.

15.11 Safety Devices

(1) All plant and equipment used on or around the site shall be fitted with appropriate safety devices which shall be operational at all times and shall be regularly inspected and tested.

(2) These shall include amongst others effective safety catches for crane hooks and other lifting devices.

(3) Functioning automatic warning devices and, where applicable, an up-to-date test certificate, for cranes and hoists.

(4) All plant and equipment used on or around the site shall be operated by suitably trained and qualified personnel with valid licenses from the appropriate authorities.

15.12 Testing and Certification of Lifting Gear

(1) The Contractor shall provide and maintain safe mechanical cranes, hoists and conveying facilities for the lifting and transport of materials and shall comply with all relevant codes of practice for safe use of cranes.

(2) All cranes, hoists and the like shall be fitted with audible overload warning devices.

(3) All such equipment shall be regularly maintained in accordance with manufacturers' recommendations and standards having regard to local legislation and recommendations from the appropriate statutory authority.

(4) Prior to use on site, all lifting appliances and lifting gear shall be tested to an approved safety margin and suitably identified in accordance with the requirements of the current legislation.

(5) The test certificate shall be submitted to the Engineer for review prior to the use of such equipment on site.

(6) The safe working load shall be clearly and indelibly marked on all lifting appliances and lifting gear either by stamping or by the addition of permanently secured tag labels.

(7) Stamping shall not be permitted on any stress-bearing part.

(8) The Contractor shall prepare and maintain an up-to-date register containing test certificates of all lifting and hoisting equipment used on the Works.

(9) The Contractor shall notify the Engineer of the person responsible for maintaining this register.

(10) The register shall, from the commencement of construction, be available on site for inspection by the Engineer and relevant authorities.

(11) Heavy plant or equipment which does not come under the jurisdiction of any local statutory legislation shall be subject to the testing and examination requirements as recommended by its manufacturer or in the absence of such, it shall be the responsibility of the Contractor to submit a standard or method of testing and examination to the Engineer for review.

(12) Competent operators with certificates certifying that the proposed operator has received training in the general principles of crane operation and specific training in the type of lifting or hoisting equipment he is required to operate shall be provided for the control of all lifting and hoisting equipment.

15.13 Fire Regulations and Safety

(1) The Contractor shall provide and maintain all necessary temporary fire protection and fire fighting facilities on the site during the construction of the Works, and shall comply with all requirements of the local fire services department.

(2) These facilities may include, without limitation, sprinkler systems and fire hose reels in temporary site buildings, raw water storage tanks and portable fire extinguishers suitable for the conditions on the site and potential hazards.

(3) The Contractor shall submit details of these facilities to the Engineer for review prior to commencement of work on the site.

(4) If, in the Engineer's opinion, the use of naked lights may cause a fire hazard, the Contractor shall take such additional precautions and provide such additional fire fighting equipment as the Engineer considers necessary.

(5) The term "naked light" shall be deemed to include electric arcs and oxyacetylene or other flames used in welding or cutting metals.

(6) Oxyacetylene burning equipment will not be permitted in any confined space. If required, the burning equipment of the oxy-propane type shall be used.

15.14 Electrical Safety

15.14.1Interface with Indian Railway Operations

(1) The Contractor will review the interfaces with Indian Railway’s operations and prepare a specific safety plan for all works that may affect the operating railway.

(2) The Contractor will comply with and incorporate Indian Railway’s rules and regulations for track, signalling and operations possessions into his safety plan and will operate a permit to work system for all works which may affect the operations of the existing railway.

(3) Similarly, the site safety plan shall consider with other interfacing contractors in the closed vicinity of the Employer.

15.4.2 Safety measures while working in OHE area

(a) While working near the OHE area, as a maximum the safety guidelines as specified in

para 20301, 20327, 20334, 20335, 20529, 20612, 20614, 20714, 20825, 20833, 21206 and 21207 of Volume II, Part 1 of AC Traction Manual of Indian Railways shall be followed

(b) No work close to the live OHE shall be carried out without power block and unless the work area is properly earthed and specific approval from Engineer / Employer

(c) A minimum distance of 2m shall be maintained between live OHE wire and any body part of the workmen or tools or metallic support etc.

(d) No electric connection shall be tapped from OHE.

15.4.3 Safety Requirements for Electrical Works

(a) The Indian Electricity Rules 1956 and Indian Electricity Act 2003 as amended up to date, shall be followed. The detailed instructions on safety procedures given in I.S.S. and Indian Electricity Rules, respective State Electricity Authorities' regulation with up to date amendment shall be applicable.

(b) No flammable materials shall be stored in places other than the rooms specially constructed for this purpose in accordance with the provisions of Indian Explosives Act.

(c) Protective and safety equipment such as rubber gauntlets or gloves, earthing rods, linemen's belt, portable artificial respiration apparatus, safety goggles etc., shall be provided as per the requirement of the Work.

(d) Necessary number of caution boards such as "Man working on line, Don't switch on" shall be readily available in the vicinity of electrical installation.

(e) Standard first aid boxes containing materials as prescribed by the St. John's Ambulance Brigade or Indian Red Cross shall be made available.

(f) Charts displaying methods of giving artificial respiration to a recipient of electrical shock (one in English and another one in the regional language) shall be prominently displayed at appropriate places.

(g) No work shall be undertaken on live installations, or on installation, which could be energized unless one another person is present to immediately isolate the electric supply in case of any accident and to render first aid, if necessary.

(h) When working on or near live installations, suitable insulated tool should be used, and special care should be taken to see that those tools accidentally do not drop on live terminals causing shock or dead short.

(i) Before starting any work on the existing installation, it shall be ensured that the electric supply to that portion is cut off. Precautions, like displaying "Men at Work" caution boards on the controlling switches, removing fuse carrier from these switches shall be taken against accidental operation. Caution boards shall be kept with the person working on the installation.

(j) All electrical panels & switchgear shall conform to relevant Standard.

(k) All external enclosures shall have degree of protection not less than IP-54

(l) All equipment/system shall conform to relevant IEC standard on Electromagnetic Compatibility (EMC).

(m) Cable routes of all the newly laid cables by the Contractor shall be identified with concrete markers.

15.15 Standby Equipment

(1) The Contractor shall provide adequate stand-by equipment to ensure the safety of personnel, the Works and the public.

15.16 Co-operation

(1) The Contractor shall provide full co-operation and assistance in all safety surveillance carried out by the Engineer or the Employer. Any breaches of the site safety plan or the statutory regulations or others disregard for the safety of any persons may be the reason for the Engineer to exercise his authority to require the Contractor's site representative's removal from the site.. Besides this Engineer may impose token penalty for such lapses as considered fit. .

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APPENDIX - 13

TRAFFIC BLOCK (POSSESSION) MANAGEMENT

1. GENERAL

(1) The Contractor shall comply with the traffic block (Possession) management system operated by Indian Railways (IR).

(2) The Contractor shall appoint a responsible person who shall coordinate with IR and with the other adjacent civil, structures and track works contractors and the systems contractor as applicable and who will act as the traffic block coordinator for the Contractor only.

(3) The person appointed must have experience of IR operations and must be fully aware of IR rules and regulations related to possession of track for construction of railway works and in accordance with IR regulations to issue possession requests.

(4) For the purpose he shall be duly certified in accordance with the said rules.

2. POSSESSION PERIODS

(1) The Contractor may use possessions on the line for execution of works as per approved plan following strict safety procedures.

(2) Line closures may be agreed subject to IR approval.

(3) The Employer gives no warranty that line closures and possession periods will be available during the period of the Works.

(4) The Employer will however provide any assistance necessary to the Contractor to enable him to obtain the line closures and possessions required by him for the Works but will not be responsible if any Possession requests are refused by IR.

(5) The Contractor shall prepare technological and organizational schedule for construction which shall include the work times in the weekends and during the dark part of the day.

(6) The Contractor shall submit his requests for ‘possessions’ at least fourteen (14) days earlier and inform IR at least 48 hours earlier if he is not able to use the permitted ‘possessions’.

(7) Any fees which may become leviable on account of track possessions required by the Contractor for permanent or temporary works shall not be payable by the Contractor. However, penalties, if any, levied by Indian Railways caused due to any careless working or otherwise of violation of the Terms and Conditions of the track possessions, shall be payable by the Contractor.

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APPENDIX - 14

DESIGN STANDARDS

Please refer to PART 2, SECTION V(B):PARTICULAR SPECIFICATIONS

APPENDIX - 15

DETAILS OF WORKS ALREADY EXECUTED

a) Following materials will be given free of cost to the contractor against Indemnity Bond from the nominated depot except Video Wall which is installed at OCC:

Sl. No.	S&T Material	Unit	Approximate Quantity
1	4 Quad x 0.9 mm Cable	Kms	73
2	6 Quad x 0.9 mm cable	Kms	498
3	6 Core x 1.5 sqmm cable	Kms	519
4	12 Core x 1.5 sqmm Cable	Kms	748
5	30 Core x 1.5 sqmm Cable	Kms	9
6	2 Core x 25 sqmm AL Power cable	Kms	34
7	24 Fibre Armoured Optic Fibre Cable	Kms	1000
8	MSDAC Equipment (Frauscher make)	DPs	280
9	Video Wall screens for display of TMS and SCADA (Delta Make)	Nos.	48

Note:

1. These materials shall be taken over by the contractor within three months from the date of issue of letter of acceptance.
2. The above material will be provided on ‘as it is where it is’ basis.
3. For the purpose of inspection of these materials bidder may contact CGM/E/ALD.

LIST OF EXECUTED S&T WORKS

List of works already executed in the section is given below, however the quantities are tentative. Exact quantity has to be assessed by the contractor jointly with the Engineer.

Sl.No.	Description	Quantity (Approx.)	Remark
1	Signalling Cable Laying	530 Km	This includes cables of various sorts laid in trench stretch of 45 Km.
2	HDPE Duct laying for OFC	1200 Km	Laid in two different trench stretch of 600 Km. Each trench has two HDPE ducts.
3	OFC blowing through HDPE Duct	400 Km	Laid in two different trench stretch of 200 Km. Each trench has two OFC in HDPE ducts.
4	Video wall screens at OCC	48 Nos	36 Nos for TMS and 12 Nos for SCADA.

Details of Trenching, Ducting & OFC Blowing work for Trench-1 completed Block Section Wise (All figures in KM)

Sr. No.	Block section		Chainage		Trenching T1	Ducting T1	OFC Blowing T1
	From	To	From	To	Completed	Completed	Completed
1	Deen Dayal Upadhyay	New Ahraura Road	127.694	136.575	0.836	0.836	0.000
2	New Ahraura Road	New Dagmagpur	140.931	161.175	17.429	16.888	8.411
3	New Dagmagpur	New Mirzapur Road	163.865	191.349	22.238	21.388	0.000
4	New Mirzapur Road	New Unchdih	194.050	233.061	32.663	31.726	0.000
5	New Unchdih	New Karchhana	236.169	267.138	29.277	28.930	2.955
6	New Karchhana	New Manauri	273.069	294.186	16.318	15.423	0.000
7	New Manauri	New Shujatpur	297.156	332.191	32.516	32.399	14.502
8	New Shujatpur	New Rasulabad	334.925	376.904	41.707	41.442	27.988
9	New rasulabad	New Malwan	379.596	421.398	39.654	39.424	11.135
10	New Malwan	New Kanpur	424.132	458.731	34.269	34.269	9.892
11	New Kanpur	New Bhimsen	463.443	484.259	19.480	19.460	9.212

12	New Bhimsen	New Bhaupur	488.380	508.081	17.827	17.752	0.000
					304.214	**299.937**	**84.095**

Details of Trenching, Ducting & OFC Blowing work for Trench-1 completed Station Wise

(All figures in KM)

Sr. No.	**Station**	**Chainage**		**Trenching T1**	**Ducting T1**	**OFC Blowing T1**
		From	**To**	**Completed**	**Completed**	**Completed**
1	Deen Dayal Upadhyay			0.164	0.164	0.000
2	New Ahraura Road	135.771	140.931	0.000	0.000	0.000
3	New Dagmagpur	161.175	163.865	2.355	2.210	0.000
4	New Mirzapur Road	191.349	194.050	0.939	0.909	0.000
5	New Unchdih	233.061	236.169	2.950	2.950	0.000
6	New Karchhana	267.138	273.069	5.292	5.252	0.000
7	New Manauri	294.186	297.156	1.610	1.324	0.000
8	New Shujatpur	332.191	334.925	2.734	2.571	0.000
9	New rasulabad	376.904	379.596	2.225	2.225	1.314
10	New Malwan	421.398	424.132	1.466	1.466	1.466
11	New Kanpur	458.731	463.443	4.235	4.235	2.318
12	New Bhimsen	484.259	488.380	4.107	4.107	0.000
				28.077	**27.413**	**5.098**

Details of Trenching, Ducting & OFC Blowing work for Trench-3 completed Block Section Wise

(All figures in KM)

Sr. No.	**Block section**		**Chainage**		**Trenching T3**	**Ducting T3**	**OFC Blowing T3**
	From	**To**	**From**	**To**	**Completed**	**Completed**	**Completed**
1	Deen Dayal Upadhyay	New Ahraura Road	127.694	136.575	4.082	4.082	0.000
2	New Ahraura Road	New Dagmagpur	140.931	161.175	17.912	17.912	8.049
3	New Dagmagpur	New Mirzapur Road	163.865	191.349	21.677	21.508	2.830
4	New Mirzapur	New Unchdih	194.050	233.061	34.997	34.655	8.273

	Road						
5	New Unchdih	New Karchhana	236.169	267.138	29.408	29.372	15.192
6	New Karchhana	New Manauri	273.069	294.186	17.601	15.538	0.000
7	New Manauri	New Shujatpur	297.156	332.191	33.228	33.218	13.904
8	New Shujatpur	New Rasulabad	334.925	376.904	41.095	41.061	22.064
9	New rasulabad	New Malwan	379.596	421.398	40.548	40.493	17.926
10	New Malwan	New Kanpur	424.132	458.731	34.237	34.237	32.090
11	New Kanpur	New Bhimsen	463.443	484.259	19.564	19.564	6.590
12	New Bhimsen	New Bhaupur	488.380	508.081	18.107	18.107	0.000
					312.456	**309.747**	**126.918**

Details of Trenching, Ducting & OFC Blowing work for Trench-3 completed Station Wise (All Figures in KM)

Sr. No.	**Block section**	**Chainage**		**Trenching T3**	**Ducting T3**	**OFC Blowing T3**
	From	**From**	**To**	**Completed**	**Completed**	**Completed**
1	Deen Dayal Upadhyay			0.865	0.865	0.000
2	New Ahraura Road	135.771	140.931	2.331	2.331	0.000
3	New Dagmagpur	161.175	163.865	1.952	1.952	0.000
4	New Mirzapur Road	191.349	194.050	0.721	0.698	0.000
5	New Unchdih	233.061	236.169	3.108	3.108	1.239
6	New Karchhana	267.138	273.069	5.574	5.524	0.000
7	New Manauri	294.186	297.156	1.225	1.225	0.000
8	New Shujatpur	332.191	334.925	1.594	1.594	0.000
9	New rasulabad	376.904	379.596	2.110	2.110	0.246
10	New Malwan	421.398	424.132	2.734	2.734	2.734
11	New Kanpur	458.731	463.443	4.174	4.174	2.128
12	New Bhimsen	484.259	488.380	4.121	4.090	0.000
				30.509	**30.405**	**6.347**

Details of Signal Cable Laying for Trench-2 completed Block Section wise (All figures in KM)

Sr. No.	Block Section	Executed
1	DDU-New ARW	0
2	New ARW-NewDAP	0
3	New DAP-New MZP	1.763
4	New MZP-New ULD	1.79
5	New ULD-New KCN	4.792
6	New KCN-New MRE	0
7	New MRE-New SJT	14.238
8	New SJT-New RUB	7.607
9	New RUB-New MWH	8.27
10	New MWH-New CNB	8.213
11	New CNB-New BZM	0
12	New BZM-New BPU	0
	Total of Block Section	**46.673**

Details of Trenching, Ducting & OFC Blowing work for Trench-1 completed on Link Line

Sr. No.	Block section	Chainage		Trenching T1	Ducting T1	OFC Blowing T1
	From	**From**	**To**	**Completed**	**Completed**	**Completed**
1	Deen Dayal Upadhyay (DFCCIL)-Deen Dayal Upadhyay (IR)			0.000	0.000	0.000
2	Ahraura Road (DFCCIL)-Jeonathpur (IR)	137.309	681.051	0.000	0.000	0.000
3	New Karchhana (DFCCIL) - Cheoki (IR)	269.746	1350.679	0.000	0.000	0.000
4	New Karchhana (DFCCIL) - Iradatganj (IR)	270.785	1340.552	0.000	0.000	0.000
5	New Kanpur (DFCCIL)-Rooma (IR)	462.167	1002.818	2.800	2.800	2.083
6	New Bhimsen (DFCCIL)-Bhimsen(IR)	487.091	1888.58	1.481	1.481	0.000
				4.281	**1.281**	**2.083**

Details of Trenching, Ducting & OFC Blowing work for Trench -3 completed on Link Line

(All Figures in KM)

Sr. No.	Block section	Chainage		Trenching T3	Ducting T3	OFC Blowing T3
	From	**From**	**To**	**Completed**	**Completed**	**Completed**
1	Deen Dayal Upadhyay (DFCCIL)-Deen Dayal Upadhyay (IR)			0.000	0.000	0.000
2	Ahraura Road (DFCCIL)-Jeonathpur (IR)	137.309	681.051	0.000	0.000	0.000
3	New Karchhana (DFCCIL) - Cheoki (IR)	269.746	1350.679	0.000	0.000	0.000
4	New Karchhana (DFCCIL) - Iradatganj (IR)	270.785	1340.552	0.000	0.000	0.000
5	New Kanpur (DFCCIL)-Rooma (IR)	462.167	1002.818	2.074	2.074	0.000
6	New Bhimsen (DFCCIL)-Bhimsen(IR)	487.091	1888.58	1.460	1.460	0.000
				3.534	**4.281**	**0.000**

Status of Auto Location Huts (ALHs) to be constructed by contractor

S.No.	ALH No.	Chainage	Tentative Status of ALH
1	201	129.080	Column Below Plinth
2	202	133.680	Excavation
3	203	142.752	Slab completed
4	204	148.281	Slab completed
5	205	153.490	Plaster work completed
6	206	158.160	Plaster work completed
7	207	167.820	Brick work completed
8	208	173.700	Brick work completed
9	209	177.620	Tie beam completed
10	210	183.640	PCC completed
11	211	189.403	Slab completed
12	212	197.785	Column Below Plinth
13	213	202.040	Brick work completed
14	214	207.964	Slab completed
15	215	213.700	Brick work completed
16	216	219.400	Slab completed
17	217	224.900	Slab completed
18	218	229.900	Slab completed
19	219	240.400	Slab completed
20	220	243.976	Slab completed
21	221	248.960	Slab completed
22	222	254.504	Slab completed
23	223	259.542	Slab completed
24	224	265.700	Slab completed
25	225	275.060	Column Below Plinth
26	226	280.991	Column Below Plinth
27	227	287.038	Column Below Plinth
28	228	292.558	Plinth Beam completed
29	229	301.180	Column Below Plinth
30	230	306.500	Foundation completed
31	231	312.640	Plinth Beam completed
32	232	318.600	Column Below Plinth
33	233	324.644	Column Below Plinth
34	234	329.200	Slab completed
35	255	465.469	Column Below Plinth
36	256	471.340	Column Below Plinth
37	257	474.957	Slab completed
38	258	480.653	Brick work completed
39	259	491.500	NIL
40	260	497.760	Column Below Plinth
41	261	502.100	Excavation
42	262	506.400	NIL

Status of Relay Huts (RHs) to be constructed by contractor

S.No.	Station Name	Chainage	RH No.	Tentative Status
1	New BZM	484.440	RH-01	NIL
		486.940	RH-02	NIL
2	New MRE	294.980	RH-01	NIL
		332.300	RH-02	Column below Plinth beam
3	New KCN	267.480	RH-01	NIL
		269.740	RH-02	NIL
4	New UND	233.720	RH-01	Column below Plinth beam
		235.840	RH-02	Layout & Marking
5	New MZP	191.700	RH-01	Layout & Marking
		193.680	RH-02	NIL
6	New DAP	161.500	RH-01	Column below Plinth beam
		163.440	RH-02	Slab
7	New ARW	138.200	RH-01	NIL
		140.480	RH-02	NIL
8	DDU	To be decided	To be decided	NIL

List of ALH and RH to be handed over by DFCCIL to Bidder

1. Auto location huts (ALHs)

The present status is given below. However, civil work of these ALHs will be completed by Employer and handed over to successful contractor.

S. No.	ALH No.	Chainage	Status of ALH
1	235	336.240	Plinth beam completed
2	236	342.244	Plinth beam completed
3	237	348.740	PCC Completed
4	238	354.540	Slab completed
5	239	360.586	Column upto Slab
6	240	366.934	Plinth beam completed
7	241	372.650	Foundation Completed
8	242	383.350	Foundation Completed
9	243	389.500	Slab completed
10	244	395.050	Tie beam Completed
11	245	400.757	Slab completed
12	246	406.590	Slab completed
13	247	412.250	Foundation Completed
14	248	417.700	Foundation Completed
15	249	427.259	Slab completed
16	250	432.905	Layout and Marking
17	251	437.035	Foundation Completed
18	252	442.999	Slab completed
19	253	448.942	Slab completed
20	254	454.917	Plinth beam completed

2. Relay Huts (RHs)

The present status is given below. However, civil work of these RHs will be completed by Employer and handed over to successful contractor.

S. No.	Station Name	Chainage	RH No.	Status
1	New SJT	332.530	RH-01	Column below Plinth beam
		334.540	RH-02	Column below Plinth beam
2	New RUB	377.240	RH-01	Column below Plinth beam
		379.230	RH-02	-
3	New MHW	421.630	RH-01	Column below Plinth beam
		423.640	RH-02	Column below Plinth beam
4	New CNB	459.500	RH-01	Column below Plinth beam
		461.300	RH-02	Column below Plinth beam

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BID DOCUMENT FOR

BALANCE WORKS OF DESIGN, SUPPLY, CONSTRUCTION, TESTING AND COMMISSIONING OF SIGNALLING, TELECOMMUNICATION AND ASSOCIATED WORKS OF DOUBLE TRACK RAILWAY LINES UNDER CONSTRUCTION ON A DESIGN BUILD LUMP SUM BASIS FOR DEEN DAYAL UPADHYAY - NEW BHAUPUR SECTION OF EASTERN DEDICATED FREIGHTCORRIDOR

SIGNALLING AND TELECOMMUNICATION WORKS

CONTRACT PACKAGE: 203(R)

Issued on: 27.08.2020

IFB No.: HQ/S&T/EC/D-B/DDU-BPUN

Part-2, Section V(B), Volume 7

Particular Specifications

Signalling Works

Employer:

DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LIMITED

A GOVERNMENT OF INDIA ENTERPRISE

under

MINISTRY OF RAILWAYS

INDIA

PARTICULAR SPECIFICATIONS: SIGNALLING WORKS

Table of Contents

CHAPTER 1: INTRODUCTION

1.1 Introduction

1.1.1. Eastern Dedicated Freight Corridor (EDFC) Railway project will run from Ludhiana to Dankuni. Phase 2 of the EDFC project involves construction of the stretch from Deen Dayal Upadhyay to New Bhaupur. The details of the section are given in Para 2.1 of General Specifications,Vol.1 Part 2 Section V(A).

1.1.2. The Deen Dayal Upadhyay- New Bhaupur section (EDFC Phase 2) will be double line railway track with 12 stations, of which 6 stations will be Crossing stations and 6 will be Junction stations. Details of Crossing and Junction stations are given in Para 2.1.4 of General specification Vol.1 Part 2 Section V(A).

1.1.3. There are 75 level crossing gates in EDFC Phase-2, which will be replaced by ROB/RUB in a phased manner. It is anticipated that on 15 LC Gates, the work of ROB/RUB is not likely to be completed before the commissioning of Freight Corridor in the Section. Therefore these 15 LC Gates will be required to be interlocked with Gate Signals. The details of these Level Crossings are given in Para 2.1.5 of General specification Vol.1 Part 2 Section V(A).

1.1.4. To provide integrated maintenance facilities for all functions – Civil, Electrical, S&T at a centralized location, Integrated Maintenance depots (IMD) – 3 Nos. and Integrated Maintenance Sub Depots (IMSD) – 5 Nos. have been planned to be constructed. The details of maintenance depots are covered in Para 2.1.6 of General specification Vol.1 Part 2 Section V(A).

1.1.5. The EDFC Centralized Operational Control Centre, provided at Allahabad under CP 104, will be used to house the Train Management system (TMS) and Traction Power SCADA system of EDFC Phase 2. The details of OCC are covered in Para 2.1.8 of General specification Vol.1 Part 2 Section V(A).

1.1.6. The Civil Structures Track and Electrification works in Deen Dayal Upadhyay-New Bhaupur section are have started. The present work is for construction of Signalling and Telecommunication system on Deen Dayal Upadhyay-New Bhaupur section of EDFC. This specification details the technical requirements for the Signalling system to be implemented on this section.

1.1.7. The Contractor shall consider the Project Objectives and scope of works contained in this chapter and then using the requirements given in this document develop an appropriate Signalling system that meets the System requirements for design, implementation and support.

1.2 Objective

1.2.1 The objective is to design, build, install and test a safe and reliable Signalling system for the Deen Dayal Upadhyay-New Bhaupur section of EDFC.

1.2.2 The project section is divided into number of stations. Each station will be responsible for the operation of the section in its control area. The control in each station is to be accomplished by a local control system and will be staffed by Station Masters.

1.2.3 Safety is of primary concern. The aim is to minimize accidents and incidents during the implementation phase of the project, as well as to reduce operational accidents and incidents when the new Signalling system is brought into use.

1.2.4 It is an objective to install a system that will be designed to have a prolonged life cycle. As such, any of its sub-system installed should be capable of mid-life upgrade with minimal disruption to traffic operations. The Equipment is expected to remain operational during wide environmental conditions found along the proposed route.

1.2.5 The maintenance cost of the system should be kept to the minimum. The Signalling system should therefore be designed to require minimal maintenance and a suitable maintenance strategy shall be agreed with the Employer. The strategy shall incorporate the use of diagnostic data acquisition and storage to support the system maintenance authority.

1.2.6 It is an objective to install all equipment in the minimum time available commensurate with the project aims.To achieve this, the Signalling system is to be designed on a modular basis such that a generic design exists at all stations as far as possible, with variations to meet the local requirements. The contractor is encouraged to design the Signalling system in such a way that it can be pre-fabricated and tested at a central place away from the site and then delivered to site and installed. Commissioning and bringing into service of the Signalling may be achieved in sections in the most effective operational manner as agreed with Engineer.

1.2.7 It is an objective of this contract to ensure that the environmental impact associated with the Signalling works is minimized.

1.2.8 It is an objective of this contract to minimize the energy cost. The Signalling system shall be designed for minimum energy consumption.

1.2.9 It is an objective of this contract to encourage innovation and innovative solutions that allow for a rapid implementation of the Signalling system. The contractors are encouraged to offer innovative, modular solutions to meet the system requirements.

1.3 Signalling Overview

1.3.1 The entire stretch from Deen Dayal Upadhyay to New Bhaupur will be provided with Automatic Block Signalling (ABS). Trains will run observing automatic/ semi-automatic signals enroute which in normal conditions will be set for a through and uninterrupted run.

1.3.2 The lines connecting DFCCIL Junction stations to IR stations shall be provided with Absolute Block/Slot working.

1.3.3 The Signals, Points, LC gates, Track-vacancy detection systems and other Signalling equipment at the stations and in the block sections will be controlled/monitored by Electronic Interlocking (EI) located at Stations and at Auto Location Huts along the route. The Electronic Interlocking architecture including their size, numbers, locations and bandwidth requirement for the system shall be determined by the contractor’s design. The OFC required for communication between the EI shall be provided under PS (Telecommunications) Vol. 8, Section V(B), Part-2.

1.3.4 It is a requirement that Digital Axle counter technology is used to provide primary track vacancy detection function at the Stations and the Block sections. The Track vacancy detection system architecture including size, numbers and locations shall be determined by the contractor’s design. The OFC, if used for communication between the Evaluator and the track devices shall be provided under PS (Telecommunications) Vol. 8, Section V(B), Part-2.

1.3.5 The Power supply for the Signalling System shall be provided using Integrated Power Supply (IPS)/Uninterrupted Power Supply (UPS). The Power supply scheme including

rating, quantity and locations of Power supply systems, shall be determined by the contractor's design.

1.3.6 The Train Management System (TMS) shall be housed in OCC at Allahabad. The TMS will collect real time data of important Signalling functions of stations and of block sections and display it in the OCC. For this purpose, the OFC required for communication shall be provided under PS (Telecommunications) Vol. 8, Section V(B) Part-2. The Traffic Controllers at the OCC shall be provided with an overview of the movement of trains on a Video Wall, sufficient to supervise and monitor train movements across the whole section and will control train operations by voice command using the Telecommunication System.

1.3.7 While the Traffic controllers at OCC will manage overall train operations, the operations 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 train service and management information from the Traffic Controller located at the OCC.

1.3.8 The 'Traction Power SCADA Control system' is being provided under Contract Package (CP 204). The Video wall for display of SCADA system as well as the SCADA Channels shall, however be provided by the Signalling system under this specification. Video Wall installed at OCC Allahabad shall be used. If any alteration/addition is required, shall be carried out by the contractor.

1.3.9 An Overview of Signalling system architecture and its Interface is placed at Appendix 7.

1.3.10 The Signal Maintenance bases will be located in IMD and IMSD. The buildings for IMD and IMSD are being provided under Contract Package CP201 & 202.

1.3.11 The 230V power supply for the Signalling system will be provided by the contractor for the Electrification works under Contract Package 204. The Bidders are requested to determine their 230V power supply requirements in accordance with Para 2.2.9 of this specification.

1.3.12 The Signalling system shall be housed in Signal Equipment Rooms (SER). While SER at Stations will be constructed as part of Station building under Contract Package 201 & 202, the Auto Location Huts (ALH) for housing Signalling and Telecommunication equipment in the Block sections shall be provided by the Contractor under PS Buildings & Structures, Vol. 9, Part 2, Section V(B). The number, size and location of ALH shall be determined by the contractor's design. Details of already constructed building Appendix-15, Part-2, Section V(A).

1.3.13 Communication of control signals for both Signalling and Telecommunications shall be distributed via an Optical Fibre Data Transmission network.

1.4 Scope of Works

1.4.1 The Signalling system scope is comprised of the following:

(1) Design and implementation of the Signalling works including Electronic interlocking and power supply arrangements at six (6) Crossing stations viz. New Dagmagpur, New Mirjapur, New Unchdih, New Manauri, New Rasulabad and New Malwan and six (6) Junction stations at Deen Dayal Upadhyay, New Ahraura Road, New Karchana, New Sujatpur, New Kanpur and New Bhimsen.

(2) Design and Implementation of Absolute Block/Slot working on single lines connecting DFCCIL and IR stations viz. New Bhimsen to Bhimsen (IR), New

Karchana to Iradatganj (IR), New Karchana to Cheoki (IR), New Ahraura road to Jeonathpur (IR), New Sujatpur to Sujatpur (IR) and New Kanpur to Rooma (IR) and lines connecting Deen Dayal Upadhyay (EDFC) and Deen Dayal Upadhyay (IR) stations. The alteration to existing signalling on IR station due to DFCCIL single line connections or for implementation of Absolute block/slot working, shall be carried out by IR.

(3) Design and Implementation of Automatic Signalling in a continuous stretch on DFCCIL Main lines from Deen Dayal Upadhyay to New Bhaupur. This shall include facility for introduction of modified automatic working during abnormal conditions such as Fog, bad weather impairing visibility etc. This is to be accomplished by modifying a mid-section automatic signal of each block section into semi-automatic stop signal, which will be interlocked with Home Signal of station ahead and Advance Starter of station in rear in both directions, in accordance with General rules of DFC. The necessary alteration in Signalling at New Bhaupur station provided under EDFC Phase I, required to implement the system shall be carried out by the Contractor.

(4) Design and Implementation of the Interlocking of 15 LC gates on proposed main line and link lines between DFCC Junction stations and IR stations. This shall include design and implementation of gateman's emergency control system and appropriate display system and power supply system. List of LC gates is placed at Para 2.1.5 of General Specification Vol. 1 part 2 section V (A).

(5) Design and Implementation of a Train Management System (TMS) for supervision, management and monitoring of train traffic on the Deen Dayal Upadhyay-New Bhaupur section. This shall include the provision of Video Wall Display for Signalling and SCADA system of Deen Dayal Upadhyay-New Bhaupur section. Video Wall installed at OCC Allahabad shall be used. If any alteration/addition is required, shall be carried out by the contractor.

(6) Design and implementation of Service & Diagnostic (S&D) system for monitoring and supervision of health of Signalling equipment and its power supply.

(7) "Design and Implementation" means all activities associated with designing a Signalling system to meet the Employer's requirements, manufacture & supply, storage, Installation/Construction, testing and commissioning, training, supply of spares and documentation, removal of temporary works, handover of the system to the Employer and support during Defect Notification period and beyond as per provisions of Employers Requirements.

(8) All associated works required for satisfactory completion of works as defined in this Particular specifications.

1.5 Contractor's Responsibility for Discrepancy:

1.5.1 All designs and drawings submitted by the contractor shall be based on a thorough study and shall be such that the contractor is satisfied about their suitability. The Engineer's approval will be based on these considerations, notwithstanding the approval communicated by the Engineer, during the progress of the contract for designs and drawings, prototype samples of components, materials and equipment after inspection of materials, after erection and adjustments to installations. The ultimate responsibility for correct design and execution of work shall rest with the contractor.

1.5.2 The contractor shall be responsible for and shall bear and pay the costs for any alteration of

works arising from any discrepancies, errors or omissions in the design and drawings supplied by him, whether such designs and drawings have been approved by the Engineer or not.

1.6 Deployment of Key Personnel for signal & telecom work at site:

Contractor shall ensure deployment of key personnel as per the list given in Part 1, Section III Clause 2.2 of requisite experience and qualification (minimum graduate in relevant field) during the execution of the work in addition to semi-skilled and skilled staff.

1.7 Anti-theft Arrangement:

(1) Suitable Antitheft arrangement should be provided for MSDAC Field DP, Location Boxes, Point Machine, MF Earth Electrode etc.

(2) Antitheft arrangement shall be aesthetical design and robust. The final design shall be submitted to Engineer for approval.

1.8 Relevant Documents

1.8.1 This Particular Specification (PS) shall be read in conjunction with the General Conditions of Contract (GCC), Particular Conditions of Contract (PCC), the General Specification (GS) and any other document forming part of the Contract.

1.8.2 In the event of a conflict between the GS and PS (Signalling), the requirements of PS (Signalling) shall prevail.

1.8.3 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 - General Specification.
(3) Indian Standards referenced herein.
   a. DFC General Rules.
   b. Indian Railway Signal Engineering Manual
   c. Indian Railway Telecom Manual
   d. Indian Railway Standard Specification (IRS specification).
   e. RDSO Draft Standard specification (RDSO SPN specification).
(4) International Standards referenced herein.
(5) Other International Standards.
(6) Other National Standards.

1.8.4 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.

1.9 Implementation of Work:

1.9.1 The Contractor shall coordinate with CST contractor for detailed interface requirements on the railway route alignment and mainline track layout in accordance with Employer's Requirements and other design criteria. Also it will coordinate for interfacing with the system contractors of the adjoining sections of EDFC. At junction station and LC Gates where there is interfacing with IR is required, contractor will coordinate with IR.

1.9.2 The contractor is required to supply latest version of Signal & Telecom equipments as per the

latest guidelines issued from RDSO at the time of procurement.

1.9.3 The Contractor shall prepare a plan in accordance with the Employer's Requirements that shall be presented for the Engineer's review and shall as a minimum describe the content, duration, timing and location of all training activities proposed by the Contractor. The Contractor shall prepare and supply all necessary training documentation and operating and maintenance manuals for the review of the Engineer.

1.10 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 system and any other fact or not mentioned herein which may cause such a dispute. The entire responsibility to settle any such disputes/matters shall lie with the Contractor.

(End of Chapter 1)

CHAPTER 2: SYSTEM REQUIREMENTS

2.1 Introduction

2.1.1 A new Signalling system is required for the Deen Dayal Upadhyay-New Bhaupur railway line. The main components of the system shall be Electronic Interlocking, Track vacancy detection using DAC, LC gate Interlocking, Line Side Signals, Point Machines, Service and diagnostic system and Train Management System

2.1.2 The signalling system shall be engineered for a minimum service life of 20 years, based on continuous operation of the system. The life of individual signalling equipment shall not be less than that stipulated in the Finance Code of Indian Railway with latest amendment.

2.1.3 For reasons of operational availability, a distributed control capability is required with an interlocking used within each station area of control to ensure points, LC gates and signals do not conflict and that the train is protected from point movement and LC gate opening during its passage.

2.1.4 It is anticipated that Centralized Traffic Control (CTC) and Train Protection Warning System (TPWS) may be required in the future, therefore system provided under this contract shall be designed as demonstrable to be “future proofed” for the same.

2.1.5 The System shall be designed in such a manner that the failure of a single item of 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.

2.1.6 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 Para 18.0 of GS Vol. 2 Part 2 Section V(A).

2.1.7 The System shall be designed to be repaired without loss of overall functionality.

2.1.8 The System shall be designed to operate correctly and safely within a 25 KV AT feeding system environment and shall present no hazards to personnel.

2.1.9 The System design shall be modular and amenable to assembly and testing away from the final installation site.

2.1.10 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.

2.1.11 The System shall be designed and installed in such a manner that theft and vandalism are discouraged. Line 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.

2.1.12 The System shall be designed to incorporate a Service and Diagnostic system to be used to support railway maintenance activities.

2.1.13 The System shall be designed to interface with Signalling systems on adjacent sections of EDFC and Signalling systems of linked IR stations.

2.2 Signalling System Requirements

2.2.1 **General**

(1) Automatic Signalling shall be provided on Main lines in a continuous stretch from Deen Dayal Upadhyay to New Bhaupur with 4 Aspect Colour Light Signals (MACLS) at a nominal spacing of 2 Km.

(2) Facility shall also be provided for introduction of modified automatic working during abnormal conditions such as Fog, bad weather impairing visibility etc. This is to be achieved by modifying a mid-section automatic signal in each direction and in each block section into modified semi-automatic stop signal and suitably interlocking it with Home Signal of station ahead and Advance Starter of station in rear in accordance with DFC General rules Clause(2) of rule 105, Chapter-VI.

(3) Absolute block working on single line connections between DFCCIL and IR stations shall be provided using Solid State Block proving by Axle Counter as per RDSO spec. RDSO/SPN/175/2005 with latest amendment or Block proving by Axle Counter using UFSBI as per RDSO spec. IRS: S105/2012 with latest amendment. Wherever provision of Absolute Block working as described above is not feasible provision of Slot working with all necessary safety features and counters be considered.

(4) Station area shall be designed for maximum flexibility and shall be fully signalled in accordance with current IR practices.

(5) Interlocking of Stations and Block sections shall be provided using Electronic Interlocking.

(6) Track Vacancy Detection System shall primarily use Digital Axle Counters (DAC).

(7) All level crossing gates shall be provided with Electric lifting barrier and interlocked wherever Level crossing gates serve both DFCCIL and IR tracks together. The work shall be suitably coordinated with IR.

2.2.2 Signals

(1) **System Requirements**

(a) All Signals and Subsidiary signals should be designed and implemented in accordance with DFC General Rules and Signal Engineering Manual and other requirements of this specification.

(b) The design of the proposed Automatic Block Signalling system shall, as far as possible avoid positioning of signals at following locations, where they can display a red ‘STOP’ aspect:

(i) Where trains may stop inside a tunnel;
(ii) Where trains may stop on top of a viaduct;
(iii) Where trains may stop across a junction or a point of conflict with another train;
(iv) Where trains may stop over a level crossing;
(v) Where trains may stop inside or too close to an OHE Neutral Section;
(vi) Where trains may stop at steep up/down gradient
(vii) Where trains may stop in a position that is considered dangerous.

(c) All Main line signals shall be 04 aspect Colour light automatic/semi-automatic line side signals. The signals on the loop lines shall be 2/3 aspect signals.

(d) All the automatic/ semi-automatic signals shall be fitted with A marker disc, G marker disc, illuminated ‘A’ marker and illuminated ‘AG’ marker in accordance with

provisions of DFC General Rules and Signal Engineering Manual.

(e) A CSL board shall be provided on the Starter signals indicating Clear Standing Length of the line.

(f) Position light type Shunt signals shall be provided below all Starter and Intermediate Starter signals.

(g) 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.

(h) Calling-ON signal shall be provided in station section below all reception and dispatch signal except the last stop signal.

(i) The Signals leading to more than one route shall be provided with Junction type Route indicators.

(j) All the Signals - Main and Auxiliary, shall be equipped with LED signal lighting units.

(2) **Technical requirements**

The Colour light tubular signal posts, outside dia. 140mm, length 3.6/4.6/5.6 meters (as per requirement) complete with surface base, anchor bolts, ladder with platform guard rail etc. shall be provided as per spec No. IRS-S-6/81 and relevant RDSO drawings.

(a) The Main running signals shall be Multi unit Colour Light Signals as per RDSO spec. No. IRS: S26-64 with latest amendmentand relevant RDSO drawings.

(b) All Main signals shall use Light Emitting Diode Signal lighting unit as per RDSO specification No. RDSO/SPN/199/2010 with latest amendment and all subsidiary signals shall use Light Emitting Diode Signal lighting unit as per RDSO specification No. RDSO/SPN/153/2011 with latest amendment. LED Signal lighting unit shall work on 110V 50 Hz AC. ECRs as per RDSO specification STS/E/Relays/AC Lit LED Signal/09-2002 with latest amendment shall only be used with LED signal lighting units.

(c) 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: S-66-84 with latest amendment and relevant RDSO drawings.

(d) Installation of Signals

(i) Signals shall be installed clear of the structure gauge as per the provisions of IRSEM and SOD of EDFC.

(ii) The signal shall be so located that a clear view is available to the driver of an approaching train and is as close to the track as permissible. The actual visibility of signal shall be checked by a 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.

(iii) Location of signals shall be worked out as per the requirement of chapter XXII of IRSEM (Special Requirement of Signalling in 25 KV

AC electrified area), 2x 25 KV AC AT feed system of DFC, 25 KV AC traction system of nearby IR and DFC Schedule of dimensions for Eastern Corridor. The signal shall be located beyond electrical clearances. Suitable iron screening shall be provided if electrical clearances are not achieved.

(iv) All mountings on signal post viz. Shunt signal, 'Calling ON' signals, 'A' and 'AG' marker lights of Semi-Automatic signals shall be done using separate brackets of suitable size for each of them.

(v) Signals on posts shall be equipped with a ladder enabling access to the LED Signal lighting units as well as Shunt signal, Calling 'ON' signal and 'A' marker, 'AG' marker lights mounted on the post.

(vi) Emergency sockets shall be installed on the Signal posts under PS (Telecommunications) Vol. 8, Section V(B), Part 2 .

(vii) In case Signal units are required to be mounted on gantry, the contractor shall submit a suitable gantry design clear of SOD of DFCC Eastern Corridor & electrical clearances and amenable to maintenance for the approval of the engineer. Working instructions for maintenance of gantry mounted signals shall be suitably incorporated in the maintenance plan. Special tools, test equipment including access ladders and protective gear needed for maintenance of these gantry mounted signals shall also be supplied.

(viii) SuitableEarthing arrangements shall be provided for all signals.

(3) **Foundations for Signals**

(a) All signals shall have concrete foundation having a minimum grade of M20.

(b) The foundations must be dimensioned sufficiently for signals on posts, gantry and shunt signals.

(c) The height of the foundations must be adjusted to the geographical situation (slope, etc.) and to the location of the signals.

(d) The height of independent Position Light Shunt signal shall not exceed a maximum limit that may infringe the SOD of IR and Eastern Corridor of DFCC.

(e) The foundation drawings of Main signal and Position Light Shunt Signals (Independent) shall be proposed by the Contractor and approved by the Engineer.

(f) 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. They must be closed after final mounting.

2.2.3 Interlocking

(1) **General**

The principles of interlocking as per IRSEM shall be followed while designing the Signalling system.

(2) **System requirements**

(a) Each Station control area including adjacent block sections shall have a high integrity electronic interlocking suited to work with a Control terminal for Signalling control.

(b) Object controller/EI of distributed Interlocking for station yards shall be provided.

(c) The Electronic Interlocking shall be housed in Signal Equipment Rooms (SER) at the stations and in the block section. The number of Electronic Interlocking and their locations shall be determined by the Contractor's design.

(d) 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 Signalling Equipment Rooms at Stations and in Block section Auto location Huts where Interlocking Equipment (Central Interlocking Unit or Object Controller) is located. While the display at all interlocking Equipment (Central Interlocking Unit or Object Controller) will cover only area under control of that interlocking, the display at Station interlocking shall cover area up to the next (adjacent) stations on both sides.

(e) 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.

(3) **Technical requirements**

(a) The Electronic Interlocking (EI) shall be as per RDSO specification RDSO/SPN/192/2019 with latest amendment or RDSO/SPN/203/ 2019 with latest amendment and shall be procured from RDSO approved Vendor as per Para 4.3 of this Particular specification.

(b) Separate I/O Cards shall be used for UP & DN lines for improved functionality.

(c) It shall be capable of interfacing with TMS and TPWS systems using serial/ Ethernet/OFC ports.

(d) The System design shall ensure that required integrity of safety related vital information is maintained during communication between EI and EI/Object Controllers and between EI and TMS at OCC. In this regard, the requirements for transmission of vital safety information, as laid down in RDSO/SPN/144/2006 with latest amendment and EN 50159 shall be followed.

(e) The EI Processor shall have sufficient capacity to handle, without any degradation, the load of additional I/O when added in future utilizing available spare provisions as indicated at Para 2.2.3(4)(f).

(f) Interlocking input and output circuits and associated interface cabling shall be suitable for use within 2x25 KV AT system environment and shall be suitably protected against transient and high voltage discharge interference.

(g) All the Electronic Interlocking 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 fiber 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. The contractor shall use dark fiber, exclusively for signalling use.

(4) **Interlocking Design**

(a) The Alignment Plans Yard plans and Signal Interlocking plans (SIP) have been provided under Part 4 – Reference documents. These shall be reviewed and revalidated by the contractor from Signalling & Interlocking point of view.

(b) Based on the approved Yard plans and the Signal Interlocking plans (SIP), the contractor shall prepare the Control Tables for the Stations and Block sections. The Control Tables shall be prepared in accordance with interlocking principles provided for in the IRSEM.

(c) The approved SIP and the Tables of Control shall form the basis for the design of Signalling system.

(d) The interlocking shall be designed with a hot standby capability.

(e) EI system shall ensure the compliance of provisions of IRSEM, including the following:

(i) Route Locking after Route setting;
(ii) Route holding when train passes through the route set;
(iii) Approach locking after route cancellation when train approached the set route (including gate signals); and
(iv) On all legitimate routes, the conditions and the signal aspects shall be laid down in the Interlocking Table/chart.

(f) The System shall have provision for accommodating additional 25% of the I/O Card used as minimum spare provision, including corresponding Processor capacity for future use.

(5) **Mid-Section Semi-automatic Signal**

Mid-section modified semi-automatic signal in each direction and each block section (between two adjacent stations) shall be provided as per DFC General Rules referred at Para 2.2.1(2) above. The following system of working shall be implemented:

(i) the mid-section modified semi-automatic stop signal so provided shall be interlocked with the signals of the station ahead through axle counters and shall be controlled by the Station Master of the station ahead, the relevant indications whether the signal is in normal automatic mode or modified semi-automatic mode shall be available to the Station Masters at both the ends;

(ii) Advanced starter signal of the station in rear shall be interlocked with the mid-section modified semi-automatic stop signal in such a way that when working with 'A sign extinguished, the Advanced starter shall assume 'off' aspect or be taken 'off' only when the line is clear up to an adequate distance beyond the mid-section modified semi-automatic stop signal; similarly the mid-section modified semi-automatic stop signal shall assume

'off' aspect automatically or be taken 'off' only when the line is clear up to an adequate distance beyond the Home signal of the station ahead;

(iii) During abnormal conditions like fog, bad weather impairing visibility, the mid-section modified semi-automatic stop signal may be worked by extinguishing 'A' maker in the manner prescribed under special instructions and this action shall also ensure that the 'A' marker of the Advanced starter signal of the station in rear and Home signal of the station in advance shall also be extinguished;

(iv) During normal conditions, mid-section modified semi-automatic stop signal shall work as normal automatic stop signal;

(v) When the Loco Pilot finds mid-section modified semi- automatic stop signal with 'A' marker extinguished in 'on' position, he shall stop his train in the rear of the signal and inform this fact to the Station Master of the station ahead on approved means of communication as prescribed under special instructions; and

(vi) The Station Master of the station ahead may authorise the Loco Pilot to pass the mid-section modified semi-automatic stop signal working with 'A' marker extinguished in 'on' position through approved means of communication after ensuring conditions and procedure prescribed under special instruction.

2.2.4 Control system

(1) **System requirements**

(a) For reasons of operational availability, a distributed control capability is required on the section.

(b) There shall be a Control terminal in Hot Standby mode provided at every Station with the Station Master. There shall be no Control terminal in the block section. The Control terminal provided with the Station Master at the Station shall be used to control the Station yard and block section (part or complete), under control of the said Station Master. The display on the Control terminal shall however, include not only the current state of railway under control of the Station Master, but shall also include further display for the complete block sections up to the adjacent stations on both sides. The complete display shall be available on the Control Terminal without scrolling. Multiple terminals shall be used, as required for proper display.

(c) The Control terminal shall have hard SM key/ smart card or login facility to authenticate the operator for operation and transfer from one Control terminal to another.

(d) Diagnostic functions shall not be operative from the Control Terminal.

(e) Signalling control shall be available on only one Control Terminal (Main or Standby) at a time, to avoid conflicting control commands.

(f) Route Locking, route holding and all locking of signals as well as points and crossings shall not be affected if there is a transfer of control from one Control terminal to another.

(g) The SM shall have facility to put back any signal (including automatic signals) under his control to ON position.

(h) Certain operations are regarded as safety critical and shall require two stage commands, such as, latched key, simultaneous operation with more than two (02) switches or buttons, or co-operated operation by two persons or suitable commands through Control Terminal.

Following are some examples of safety critical operations:

(i) Route Cancellation.
(ii) Point machine Crank handle release.
(iii) Point operation under Track section failure.
(iv) Resetting of Axle Counter.

(i) The contractor shall prepare and submit list of such safety critical operations derived from an analysis of the system, along with the proposed two stage command protocol for the Engineer's review and acceptance.

(2) **Technical requirements**

(a) The Control terminal shall be provided with full redundancy (1+1) in hot standby mode. When changeover takes place, it should be ensured that requirement of 2.2.4(1) (e) & (f) continue to be met.

(b) The Control terminal shall have a latest industrial grade embedded fan less PC with no external drive and colour VDU monitor with minimum size of 32''.

(c) The Software of Control terminal shall be validated to SIL-2. All safety critical functions shall be compliant to SIL4.

(d) The Control terminal shall be connected to EI on duplicate cables, preferably OFC laid through diverse routes.

(e) The Control terminal shall work on 230V ± 10%, 50 Hz AC power supply. It shall be provided with power back up of 4 hours either through UPS/IPS of the Station Signalling system or by providing a separate UPS system.

2.2.5 Track Vacancy Detection System

(1) **System requirements**

(a) Track-vacancy detection shall be continuous, provided in the Block sections and at the Stations, on all the lines, including berthing portions of sidings at the stations.

(b) The track vacancy detection technique shall use Digital Axle Counter technology as a primary means of train detection. Where required, a secondary means of track vacancy detection can be used to supplement the primary means with the approval of the Engineer.

(c) The presence of trains and vehicles shall be positively detected, under all modes of system operation. However, Light vehicles like push trolley, dip lorry and the rail dolly etc. which are being used on Indian Railways, shall not affect the functioning of the DAC.

(d) 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.

(e) The location of the Evaluator, vital relays & other MSDAC equipment and their cabling & power supply requirement shall be determined by contractor's choice of equipment and design.

(f) The contractor should comprehensively detail the impact of system failure

on train detection and the impact on train detection once the failure is restored.

(g) At the boundary with adjacent section of EDFC, the track vacancy detection system provided shall achieve no loss of continuous detection at any point of time.

(2) **Technical requirements**

(a) The Track-vacancy detection system shall be designed to meet the requirements of SIL 4 as defined in IEC 61508.

(b) Track-vacancy detection at the stations and in the block sections shall be Multi Section Digital Axle Counters (MSDAC) as per RDSO specification no. RDSO/SPN/176/2013 with latest amendment & manufacturer's specification and procured and shall be procured from RDSO approved Vendor as per Para 4.3 of this Particular specification.

(c) High availability Single Section Digital Axle Counter (HASSDAC) as per RDSO specification no. RDSO/SPN/177/2012 with latest amendment and shall be procured from RDSO approved Vendor as per Para 4.3 of this Particular specification. SSDAC shall be provided on single lines connecting DFCCIL and IR Junction stations that are provided with Absolute block working.

(d) The detection system shall be suitable for use with UIC 60 Kg. rail.

(e) When the Signalling system starts after long duration power failure, all track sections shall show occupied until reset by the Station master(s).

(f) Track devices on crossovers /points shall be provided considering Flank Protection.

(g) The track-vacancy detection system in the Block section shall have Main system and Supervisory system. The Main and Supervisory systems shall be provided on different rails. The Supervisory system shall have a track section for every two Main system track sections. The purpose of providing the Supervisory system is to enable smooth operation by avoiding manual resetting during failure of a track section. In case the track section(s) of the Main system fail(s) with its corresponding track section of the Supervisory system showing clear or vice versa, it will automatically reset the failed track section(s). A typical scheme for Track vacancy detection system using MSDAC in Automatic Block Section is placed at Appendix 5.

(h) The track-vacancy detection system at the Stations shall have only Main system with no Supervisory system.

(i) Detection Points and Track sections

(i) In order to minimize the number of track sections in Automatic Block Section, no separate track section shall be provided for overlap portion. A single track section shall include the route as well as the overlap of the signal. Thus, one track section will overlap the adjacent track section in the signal overlap portion. This shall be applicable for Main system as well as Supervisory system, where used.

(ii) The Supervisory system, where used shall be provided on different rails from the Main system and shall not have any common DP with the Main system. Each supervisory track section shall cover not more

than two track sections.

(iii) The first DP of a track section in Automatic Block Section shall be located at least at 3 metre from the foot of the signal controlled by the track section. The other DP of this track section shall be at not less than the overlap distance from the next signal in the direction of train movement.

(iv) At the boundary with adjacent section of EDFC, the DP of the last track section shall be so located that the track section overlaps with the track section of the track vacancy detection system of the adjacent section. The distance between the two adjacent DPs shall be sufficient not to cause any interference between the two systems.

(v) The detection points attached to the rail must be protected by means of deflectors against mechanical damage that can be caused by parts of running trains.

(j) Evaluators

(i) Separate Evaluators shall be provided for UP and DOWN lines.

(ii) The Supervisory system, where used, shall have a separate Evaluator from the Main system.

(iii) However, if Evaluator of UP line Main system have spare capacity (keeping 20% of equipment used capacity reserved for further use), then it can be used for providing Supervisory system of DN line, and vice versa.

(iv) One spare set of card(s) fully programmed with site specific application/configuration data shall be provided at each site. This shall be over and above the contract spares provide under Para 8.2.7.

(k) Communication

(i) The transmission between Central Evaluator and Field units of UP and DN systems shall be in separate cables, preferably of different kinds, say OFC and quad.

(ii) The transmission between Central Evaluator and Field units of Main and Supervisory systems shall be in separate cables, preferably of different kinds, say OFC and quad.

(iii) Wherever feasible, the Supervisory system of UP line can be provided on cable for Main system of DN line and Supervisory system of DN line can be provided on cable for Main system of UP line.

(l) Resetting Arrangement

(i) Manual Resetting

(a) A suitable resetting scheme shall be designed by the contractor for manual resetting of axle counter track sections at stations and block sections. This shall be achieved through a mix of system design and the operating procedures. The scheme should avoid, to the extent possible physical verification of track at site, without affecting safety.

(b) The scheme, as far as possible, shall make use of Station Master's Control terminal for resetting operations.

(c) Provision shall be made to record every operation of resetting by non-resettable counter. The counter shall count, every time the resetting is done and shall not reset back on failure of control terminal /power supply.

(d) Preparatory reset of a track section shall not disturb other track sections in any way.

(ii) Automatic Resetting in Automatic Block section

When any track section of the Main system fails with its Supervisory track section showing clear, then the failed track section should get automatcially reset. Similarly, when the Supervisory track section fails with both track sections of the Main system supervised by it showing clear, then the failed Supervisory track section will get automatically reset. This shall considerably reduce the occasions for resorting to manual resetting & will help smooth train operation.

(3) **Installation and Entry into Service**

(a) The trackside equipment shall be installed on that side of the track, which is less dangerous for maintenance staff. It should not be installed between the main line tracks.

(b) The requirement of track maintenance machines (mechanized) shall be taken into account while installing outdoor equipment. Trackside Equipment installations shall be agreed with the Engineer prior to installation to avoid conflict with track maintenance machines.

(c) Where feasible, the trackside equipment shall be housed in sturdy lockable location boxes as an anti-theft measure. Additional anti-theft measures shall be proposed by the Contractor and approved by the Engineer at the time of installation.

2.2.6 Railway Crossings

(1) **System requirements**

(a) All the level crossing gates falling on DFCCIL shall be interlocked with signals.

(b) There are 75 level crossing gates in Deen Dayal Upadhyay-New Bhaupur section, which are being replaced by ROB/RUB in a phased manner. It is anticipated that ROB/RUB work on 15 gates is not likely to be completed before the commissioning of the section. Therefore, these 15 LC gates will be required to be interlocked. The details of these level crossings are available at Para 2.1.5 of General Specifications Vol.1 Part 2 Section V(A).

(c) For the 15 LC gates to be interlocked, Gate Huts are being constructed under Contract Packages 201 & 202. The IR gateman will operate the LC gates from the new gate lodges as per 'Working methodology for gates' at Appendix 1.

(d) At present these15 LC gates are interlocked with IR gate signals. These would be replaced with an arrangement where they cover both IR and new DFCCIL tracks and are interlocked with both IR and new gate signals on DFCCIL lines.

(e) Separate power supply system (UPS/IPS) for IR shall be installed at LC gate huts by S&T contractor for operation and interlocking purpose of LC gates.

(f) Single set of electrically operated common lifting barriers shall be provided outside the Indian Railways and DFCCIL tracks so as to protect both the railway as well as DFCCIL tracks by one set of lifting barriers. In case the distance between IR and DFCCIL tracks is such that a single set of barriers is considered unsafe or operationally unmanageable, the decision on providing two separate set of barriers under exceptional cases can be taken by the Engineer on the basis of local conditions.

(g) A separate panel for the operation of the booms shall be provided wherein the buttons be provided for raising/lowering the booms. Facility shall exist to stop the booms during operation, should a vehicle come under the boom or enter the level crossing gate during the process of closure.

(h) Colour light Road signals and audio warning shall be provided to warn the road users regarding the approach of a train.

(i) The gateman shall be provided with audio visual 'Train Approach Warning' indication from a distance of at least 6 Kms on DFCCIL lines. When the train reaches the approach warning track section in rear of the gate, a buzzer should start sounding in the gate-hut intimating the gateman of the approach of a train. The gateman will close the gate and clear the gate signal provided the relevant track sections ahead are clear. When the lowering of the booms takes place, hooter shall sound to warn the road users of an approaching train. Also, the road signals shall start displaying a flashing red light towards the road users, which shall turn to steady red when the booms are fully lowered. Provision shall be made to display actual status (red/yellow signal) of road signal at the LC gate control panel or on a separate panel. In case of Emergency Gateman will put the road traffic signal to "RED" aspect by turning road signal switch to reverse position provided on CCIP.

(j) Another warning buzzer shall also sound when the train reaches a distance of 4 Kms (approach locking track section) on DFCCIL lines. At this stage, if the gate is in closed position, track locking of the booms shall take place so that the booms cannot be opened thereafter till the passage of the train from the level-crossing. The route will get automatically released with the passage of train past the nominated track sections ahead of the gate signal. The gateman will then be free to open the gate.

(k) A common indication panel shall be provided in the new gate hut, where in indication for the 'ON' and 'OFF' aspects of gates signals (wherever provided) for both the systems (IR and DFCCIL) as also the occupation/ clearance of the controlling track circuits up to the point of approach warning shall be displayed. Direction of movement of the trains shall also be displayed on the panel. The changes in IR circuits, if required shall be carried out and commissioned by IR. Gate controlling circuit shall be changed to suit new conditions at LC gates for combining both IR and DFC gate signal. The contractor will be required to coordinate for approval of LC gate control circuit by IR and shall be required to extend concerned control of DFC relays to IR relay room and other locations of controlling LC gate. All necessary cabling to IR relay room and other locations and its termination

shall be done by the contractor. Through these extended controls of DFC gears, IR shall modify their circuit and commission the LC gate. The contractor will only be required to extend the IR gate signal aspects, approach track sections etc. to common indication panel through requisite interface as per approved LC Gate circuit by IR. At all stages necessary co-ordination shall be done by Contractor.

(l) The gateman shall be provided with facility to put back the gate signals to ON in case of emergency.

(m) Arrangement for manual emergency operation of the boom shall also be provided which can be used when it is not possible to close or open the booms electrically due to some defect or otherwise.

(n) Telephone with selective ringing arrangement between gateman and Station Master as well as between the gateman of the adjacent gate is being provided under PS (Telecommunications),Vol. 8, Section V(B), Part-2.

(o) Arrangement for fixing of Safety chain and hand operated Safety boom (Sliding boom) shall be provided for use in case of failure of lifting barriers. Indication for fixing of safety chain and hand operated boom shall also be provided on the panel of Station Master. An arrangement shall be provided for taking 'OFF' the relevant gate signal when the safety chain and hand operated boom is properly locked and detected by the system. In this case, the gate signal shall display 'YELLOW' aspect.

(2) **Technical Requirements**

(a) As all the Level Crossing gates are planned to be replaced by RUB/ROB in future, the system design for interlocking of these LC gates shall be such that it requires minimum changes to initial design for the same and the change is implemented in a cost effective and time efficient manner.

(b) The LC gates on DFCCIL shall be protected with semi-automatic Gate signals and provided with G marker disc, illuminated 'A' marker and Illuminated 'AG' marker, as per provisions of DFC General rules and Signal Engineering manual..

(c) New Electric Lifting Barrier (ELB) as per RDSO specification RDSO/SPN/ 208/2012 Ver 2.0 with latest amendment and shall be procured from RDSO approved Vendor as per Para 4.3 of this Particular specification. Fringes shall not be provided on the ELB.

(d) The lifting barrier shall work on 110V AC 50Hz single phase supply. The 110V power supply shall be extended from the nearest Signalling Power supply system at the ALH/Station.

(e) Length of the boom shall be sufficient to cover the full width of the road. The ELB shall be installed as per the provisions of IRSEM and IRPWM.

(f) The Gate signals on DFCCIL lines will be interlocked with new ELB and DFCCIL line gate signal aspects and controlling track indications are provided on Domino Type Control cum Indication Panel (CCIP) in the new gate hut.

(g) The Common Indication Panel for IR and DFCC lines shall be a Domino Type Control cum Indication Panel (CCIP), provided as per RDSO specification RDSO/SPN/186/2004 with latest amendment and shall be

procured from RDSO approved Vendor as per Para 4.3 of this Particular specification.

(h) The Contractor shall carry out all work, including laying of cables between the new ELB and IR Control cum indication panel and DFCCIL CCIP and Operating panel, required for extension of interface/displays between DFCCIL and IR systems.

(i) Road signals, audio visual warning and other safety devices for road users shall be provided at Level Crossing gates as per IRSEM. Signals at the level crossing shall display aspects to road users, as specified below:

(i) Yellow, when gate is open to road users
(ii) Flashing Red when the gate barriers are in the process of being closed
(iii) Steady Red when gate closed for road users

In addition, Audio warning to road users when gates are in the process of being closed shall also be sounded.

2.2.7 Points and Points machine

(1) **System requirements**

(a) On the EDFC system, modern turnouts and derailing switches are programmed to be used. The turnouts will be on 60 Kg rail, with thick web switches and weldable CMS crossings suitable for 25 tonne axle load and Speed potential of 100 Kmph on Main lines.

(b) The points laid in the various yards of the DFCCIL by the CST contractor shall meet all the requirements set out in paragraph 12.40 of Chapter XII of the IR Signal Engineering Manual for which the contractor shall interface with the CST contractor.

(c) The indicative list of items for which the contractor shall be required to maintain Interface with the CST contractor of Contract Package 201 & 202, is given in Appendix 3 of GS Vol. 6 Part 2 Section V(A).

(d) All the points shall be worked with Electric Point machines.

(e) 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.

(f) The Point machines and the ground connections supplied by the Contractor shall be compatible with turnouts and derailing switches provided by the CST contractor. The contractor shall interface with the CST contractor for the same.

(g) Point machines supplied shall be simple in operation and shall require minimum maintenance. They shall be small compact units, readily accessible and interchangeable.

(2) **Technical requirements**

(a) Non trailable Electric Point machines shall be as per specification IRS S 24-2002 and procured as per Para 4.3 of this specification. The Point machines shall be provided with external Clamp locking arrangement.

(b) 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 crank handle shall prevent setting

of relevant routes. The number of crank handles shall be minimized by suitable grouping such that the impact on operations is minimal when the key is taken out. Suitable means of communication shall be provided between station master and crank handle location box as per approval of the engineer

(c) 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.

(d) 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.

(e) The relative position between the point machine and the stock rail shall be fixed such that independent movement is prevented.

(f) The super imposed detection is not permitted.

(g) 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.

(h) Provision shall be made for emergency operation of points during track section failure. Each such operation shall be recorded by a suitable counter.

(i) All point operating equipment and point operation & detection circuits shall be totally immune from traction current effects or other EMI sources.

(j) Point machine wires shall be protected to prevent short-circuiting and monitored continuously for earth leakage.

(3) **Point machine Installation**

(a) Point machines installed shall present a minimum hazard to people walking along the track.

(b) As protection against dust, sand and splash water, the steel cover of the point machine must be provided with an appropriate seal. The cover shall be pad-locked.

(c) Each point machine shall be are number plate for identification.

(d) Track contractor shall lay the points and shall ensure that they meet the essential requirements before interlocking as specified in IRSEM. Contractor shall co-ordinate in this matter with Track contractor.

(e) Point machines shall be installed beside the close switch leading to high speed movement clear of all infringements as per the requirements of IRSEM, clear of DFCCIL structure gauge. Contractor shall interface with track contractor for suitable design of PSC sleepers for mounting of point machine.

(f) No point machines shall be installed in between the main line tracks.

(g) The point machine cover shall be provided with secured locking mechanism.

(h) Maximum permissible length of operation of point machines shall generally be in line with 25kV AC traction requirement of IR and shall meet the

EMI/EMC requirement of 2X25kVAC AT feed system of DFCCIL and 25kV AC traction on nearby IR.

(i) The point machine shall be installed as per RDSO/OEM checklist.

(j) The CST contractor of CP-201 & 202 may design and provide turnouts with back drive arrangement. The safety of the integrated system, including point machine, ground connections and back drive, if any shall be responsibility of the contractor. The contractor shall arrange for independent safety assessment of the integrated system.

2.2.8 Relays

(1) The various types of relays used in interlocking systems shall comply with IRS specification no. S34 and the requirements of IRS, BS or BRS specifications and shall be procured from RDSO approved Vendor as per Para 4.3 of this Particular specification

(2) Time element relays electronic type 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 in series with each other.

(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.

(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.

(5) Removal or replacement of plug-in relays/relay groups during operation shall not cause any unsafe conditions in the circuits.

(6) All relays shall, to the extent possible be housed in the Signalling Equipment room.

(7) All relays shall have minimum 10% of working contacts as spare subject to a minimum of one front and one back contact.

(8) The use of relays within the signalling sub system shall, however be minimised by design.

2.2.9 Power Supply

(1) The power supply scheme for Signalling and Telecommunication System should be based on 230V 50Hz AC supply.

(2) This230 V power supply will be provided by contractor of Contract Package 204 at all places except OCC. The 230V power supply at OCC will be provided by the contractor of Contract Package 104.

(3) At OCC, the contractor of CP 104 will provide a LT panel in which he will make available the 230V power supply for the Signalling and Telecommunication system. The Contractor shall coordinate with the contractor of CP 104 to draw the required power supply for S&T system.

(4) At other than OCC, the contractor of CP 204 will provide the Auto Change over Switch (ACO) near/inside the S&T Power Supply Equipment room on which the power supplies from various sources viz. UP AT, DN AT, Local supply, DG set (as

applicable) will be terminated. The Contractor shall coordinate with the contractor of CP 204 for above works.

(5) The Contractor shall take the Power supply from ACO to the main AC distribution panel/box common for Signalling and Telecommunication system on two independent power cables laid through diverse routes.

(6) The Contractor is required to create MCB protected 230 V, 50 Hz supply for the Signalling and Telecommunication system with sufficient capacity plus an additional 30% spare capacity for future expansion to meet the system design requirements.

(7) The Power Supply for Signalling system shall be drawn from Main AC Distribution Panels/Boxes and terminated on Signalling AC Distribution Panel/Box from where it shall be distributed to all Signalling Equipment/Signalling Power Supply Equipment operating at 230 V AC.

(8) The Contractor shall carry out a detailed power supply calculation for total Signalling load (including load of battery charging in boost mode) of every Station/ Auto Location/LC gate etc. and depending on the load requirement at each location, an Integrated Power Supply (IPS)/Uninterrupted power Supply (UPS) system of appropriate capacity shall be provided. The TMS system in OCC shall be provided with UPS of suitable capacity based on the load requirement at the OCC.

(9) All design loadings and calculations are subject to acceptance and approval by the Engineer before installation commences.

(10) The IPS provided shall be as per specification RDSO/SPN/165/2012 with latest amendment and shall be procured from RDSO approved Vendor as per Para 4.3 of this Particular specification. The UPS provided shall be as per specification placed at Appendix 2. The supply to different Signalling equipment say Electronic Interlocking, Digital Axle Counter, Relays Internal, Relays External, Point Machine, Data Logger, VDU, Block Panel etc. shall be separate, provided using separate set of additional power supply equipment with minimum N+1 redundancy. The additional power supply equipment shall be in accordance with IRS/RDSO specification (if any)/ relevant international standards.

(11) The battery backup shall be provided with VRLA maintenance free cells conforming to RDSO specification IRS: S 93-96(A) with latest amendments for capacities upto and including 500AH and to TEC specification no. GR/BAT-01/03 March 2004 with latest amendments for capacities beyond 500AH. All battery cells shall be procured as per Para 4.3 of this specification. Battery bank shall have adequate capacity to provide a backup time of minimum 4 hours with maximum depth of discharge of the battery as 70%. The batteries shall be installed on battery racks.

(12) Five numbers of 2V Cells and a spare Cell charger for charging up to 6 cells at 10% of battery AH capacity shall be provided as spare at each power supply location with the main supply.

(13) Restoration of the primary supply shall cause a seamless changeover from the IPS/UPS back to the primary supply.

(14) The Contractor shall sectionalize the power feeds to logical groups of equipment to allow for ease of maintenance and to enable maintenance to be carried out without disturbing the operation of other equipment groups.

(15) All Signalling equipment local supplies shall use redundancy techniques (ring circuit) to provide appropriate availability. The design of the distribution shall ensure that a technician can isolate the power feed to an item of equipment without affecting the operation of other equipment/items connected to the ring.

(16) An external bypass facility shall be incorporated in all IPS/UPS battery power supplies to cater for maintenance and failure requirements.

(17) Automatic monitoring of battery condition and charge state shall be provided as per Para 2.2.10 of this specification.

(18) All feeding voltages shall be monitored continuously by voltage sensors. In addition all non-earthed output supplies shall be monitored by earth leakage detectors. The said monitoring shall be possible from Service & Diagnostic (S&D) terminal at the station and OCC for which necessary sensors and interfaces shall be provided.

(19) Any failure of power supply equipment shall be recorded and displayed on the Control terminal at the Station and S&D terminal at the Station and in the OCC.

(20) Notwithstanding anything contained in this specification, the contractor shall be fully responsible for proper working of Signalling power supply system.

2.2.10 Service and Diagnostic System

(1) **System Requirements**

(a) A Service and Diagnostic (S&D) system shall be provided for monitoring and supervision of health of Signalling equipment and enable carrying out maintenance of Signalling equipment with optimum manpower and reduce the MTTR of the equipment.

(b) This system shall be able to anticipate, where practicable, failure of the equipment based on the deterioration of the parameters being monitored, thereby avoiding a potential future failure of Signalling system.

(c) The S&D terminals shall be provided with the Signal Maintainer at the Stations and with the Signal Fault Controller at the OCC. Each Signal Maintainer's S&D terminal shall monitor health of Signalling equipment under his area of control.

(d) The S&D computers shall analyze, link and evaluate indications such as status, fault, and event indications. With the help of such analysis and the specific fault conditions, the S&D computer shall identify the displayed faults. These faults shall be stored in a data-base separate for each system. Eliminated faults shall be stored for statistical evaluation at a later stage.

(e) The system should create alarms and reports for equipment maintenance and trouble shooting. It shall also be possible to send the alarms in the form of SMS to technicians in the field from the OCC. The Contractor shall provide the necessary hardware and software for the same.

(f) A soft copy of maintenance manuals shall be available on the S&D workstation, which the maintainer can refer during fault diagnostics and rectification.

(g) All Signalling 'As Built' drawing and documents of concerned station and

adjoining block section shall be loaded on the S&D workstation of the station in pdf format. The S&D Server at OCC should house the 'As Built' drawings and documents of the entire Deen Dayal Upadhyay-New Bhaupur section.

(h) The Signalling system shall indicate within 2 seconds, certain functions, but not limited to the following:

(i) Identification of failure of point throwing or detection.

(ii) Identification of signal defects.

(iii) Power supply defects including IPS/UPS defects and earth faults.

(iv) Untimely or out-of-sequence operation of equipment.

(v) Unauthorized or potentially unsafe train movement.

(i) Following Typical alarms (but not limited to) shall be generated by the system:

(i) Point machine:

- Point obstructed.
- Point machine drawing more than normal current.
- Operating voltage drop at point machine is high. .

(ii) Axle counter:

- Evaluator operating voltage low.
- State of reset.
- PCB failure.
- Abnormal movement.

(iii) Power supply system:

- Presence of input supply from AT 1 and AT 2 on ACO
- Presence of output supply from ACO
- Input mains voltage beyond limits.
- Output voltage beyond limits
- Battery charger output not available
- Working on standby system after main system failure.

(iv) Earth Leakage Detector [ELD] for cable health monitoring:

- Supply leakage occurred time.
- Supply leakage disappeared time.

(v) Linking the events of supply application and withdrawal to cable conductors with ELD alarm.

(vi) Signalling Equipment room door monitoring

- Room opening and closing events.

(vii) Block instrument:

- State of the block section relating with block instrument.
- Wrong sequencing of block operations.

(viii) Battery Monitoring Unit:

- Cell voltage beyond limits.
- Battery charging and load currents beyond limits.
- Each cell temperature beyond limits.
- State of charge of battery bank lower than the limit set.

(ix) Colour light LED Signal:

- Current drawn beyond range.
- Signal lamp lit due to faulty voltage.

(2) **Technical requirements**

(a) Parameters of each Signalling equipment/ system shall be monitored by monitoring the voltages, currents, potential free contacts etc. using a general purpose data logger. In processor based equipment like Axle counters, Electronic Interlocking etc., the data logger shall collect the diagnostic data in soft form through a port in the equipment. Scanning interval for digital inputs shall be less than 20 milliseconds.

(b) The Service and diagnostics (S&D) data network shall be established by networking all data loggers using copper quad cable or OFC channels or dark fibres as appropriate and data of all stations and block sections shall be brought to Signal Fault controller in OCC on the OFC network provided under PS (Telecommunications) Vol. 8, Section V(B) Part-2.

(c) The Data logger networking system at OCC shall consist of Servers, LAN Switches, Central Monitoring Units, Front End Processors, S&D terminal etc. with redundancy provided for each equipment. The VDU for S&D terminal at OCC shall be of minimum size 32".

(d) The Event Log should be automatically backed up by the system with a 60 day archive back up and that the active storage period is a rolling 30 days period.

(e) The S&D terminals shall be Industrial grade PC with a low noise logging printer of the latest technology provided at all stations and at OCC.

2.3 Train Management System

2.3.1 General Requirements

(1) The Train Management System (TMS) shall be a computer based train traffic supervision system operative from the Operational Control Centre (OCC) located at Allahabad. It shall automatically perform routine data logging and recording also to assist the operators.

(2) The system shall collect Signalling information from various Station and Auto Location Huts interlocking system on a real time basis. It shall also collect the train identification information from either Time Table or normally keyed in by the appropriate Controller/ Station Master.

(3) The system shall be able to detect train circulations by a logical sequence of track sections occupancies and releases. By assigning suitable numbers to these circulations it shall detect and track the trains.

(4) The system shall detect and manage alarms and logs generated in the system.

(5) The system shall enable interconnection with other TMS systems of adjacent sections/backup OCC/OCC which will be provided by other contractors.

(6) The system shall have all the capability built into it to be configured at a later stage for remote control of Signalling System for use as Centralized Traffic Control (CTC) System from OCC with minimum configuration changes and no hardware add-on. Alternatively it shall be possible to control the TMS provided in this contract from CTC in OCC provided by other contractor. The Contractor shall seek clarifications in this regard from the Engineer in the early stages of the project. The decision of the Engineer in this regard shall be final.

(7) The system shall be designed to be Modular, Robust, Scalable, Fault tolerant and based on Open architecture.

2.3.2 Functional Requirements

The TMS shall provide the following main functionalities:

(1) **Signalling Indications management**

(a) The TMS display components like Video Wall Display System at OCC and TMS Terminals in the OCC and other locations shall show real-time geographical representation of the complete Signalling System of Deen Dayal Upadhyay-New Bhaupur section, including single line tracks connecting DFCCIL Junction Stations to IR Stations. In order to show the Signalling indications of boundary sections/IR stations, the TMS shall interface with other systems at boundaries to get their status on the displays.

(b) The display views shall be configurable. It shall be possible to use all monitors for observation of the Signalling system or use one or more monitors for other functions e.g. train graph, alarms, etc.

(c) While the display views on Video walls shall normally show panoramic view of the section with train identifiers and Signalling status, the display views on the controller's work station shall show more detailed view focusing on part or single Stations/Block sections. The dynamic indications shall be updated in real time.

(d) The display shall be designed so as to achieve the overall objective of providing instant information for providing a significant action when necessary. The vital response times between a change of state and its display shall be considered in design to meet this requirement.

(e) The Video Wall Display system for Signalling system shall display schematic of track layout, important indications of Station Control terminal, Signal aspects, Points, Track sections, LC gates, EIs, other infrastructure details like stations/bridges etc. (The Engineer shall select which of the indications are to be treated as important).

(f) The Video Wall Display Panel for Signalling system shall also provide alarm indications for failure of points, signals, track sections and other equipment failures as decided by the Engineer.

(g) For providing real time status of complete Signalling system, Train Management System shall automatically acquire data pertaining to status of Signalling Functions/Equipment. Following indications in additions to those

normally provided on Video Display walls shall be provided on various TMS terminals.

(i) Signal aspects,

(ii) Points position,

(iii) Route Set/Release status,

(iv) A/AG Marker status

(v) Track section vacancy status for main and supervisory system, - Clear/Occupied/Error

(vi) Signal Failure,

(vii) Points Failure,

(viii) LC Gate Open/Close/fail,

(ix) Power supply failure

(x) ELD, Alarms,

(xi) Current Train locations

(xii) Train numbers and timetable deviations

(xiii) Temporary speed restrictions

(xiv) Any other indications

(h) Live indications to be provided to various controllers shall be based on their operational roles and these display views shall be configurable.

(i) The Contractor shall analyze Signalling indications displayed on various displays provided in TMS of other sections of EDFC and shall ensure similarity to the extent possible.

(j) It shall be possible for the TMS to send/receive the Signalling indications of its section to/from TMS of other sections of EDFC, as per interface agreement at Para 2.3.10 (4) of this specification.

(2) **Train Describer**

(a) The Train Describer System is responsible for real time management and tracking of all train information relevant to the train movements. More precisely it shall allow to:

(i) Associate a train number to each train;

(ii) Process the train stepping depending on the wayside equipment status and on the verification logics;

(iii) Provide information to Man Machine Interface (MMI) functions in order to represent graphically the train position; and

(iv) Delete the train number when the train leaves the territory.

(b) The Train Describer System shall associate a train with a unique alpha-numeric ID called a Train ID consisting of up to 8 alphanumeric characters displayed in a text box. This Train Describer System shall enable identification of all trains with Train ID as they move, and display real time information of their position and movements in sections monitored by TMS on Video Wall Display Panel and TMS Terminals. The Train ID together with

Colour/image of text box containing it shall enable identification of trains as per their loads like Container, Petroleum products, food grains etc. The Contractor shall use the same Train ID numbering scheme as used in the TMS of EDFC Phase 1.

(c) Train Describer System shall facilitate dispatch of Train from TMS Terminal of Station Master or traffic controller. Options of Scheduled Dispatch and Special Dispatch shall be available. For Scheduled Dispatch, the window shall list pre-stored Train ID to be selected along with editable Scheduled Departure Time and Destination Station from Timetable stored in Central Server. For Special Dispatch it shall be possible to enter Train ID along with other information such as Destination Station, Type of Load, Crew details etc. The scheme for the menu driven commands shall be designed in consultation with the Engineer.

(d) Train Describer System shall generate an audio visual Non-Descript Alarm (NDA) on SM's TMS Terminal as well as on Traffic Controller's TMS Terminal in OCC, if Train ID has not been selected/ entered by concerned Station Master.

(e) Generally Train ID is to be assigned only when a train enters sections monitored by TMS for the first time. Thereafter Train ID and associated information can be modified, only if required, from TMS Terminals of Traffic Controller or Station Controller. For the trains which originate in other sections, the Train ID shall be maintained or updated automatically without manual intervention when the train enters this TMS.

(f) The Train Describer System shall register following abnormal conditions in the Central Database:

(i) Change in direction of a Train.

(ii) Train Parting.

(iii) Unidentified Trains.

(iv) Trains passing a signal showing a Stop aspect.

(v) More than one train on the same Axle Counter Track section.

(g) Abnormal disappearing of Train ID shall generate an alarm and display it in different colour.

(h) The Train Describer System shall be able to handle the commands for:

(i) Insertion of a Train ID on a track or at a signal, which shall be assigned automatically to the train occupying the track.

(ii) Moving a Train ID to a different location.

(iii) Renaming a Train ID.

(iv) Exchanging one Train ID with another train describer tag.

(v) Deleting a Train ID.

(i) It shall be possible to find the location of trains by search command. It shall also be possible to view list of trains in the Train Describer System with following criteria:

(i) All trains.

(ii) Only operator identified (known) train.

(iii) Trains in a given direction.

(iv) Trains at or between specific station(s).

(v) Unidentified or delayed or cancelled trains.

(j) The Train Describer System shall send log records of the events logged including the following information to Central Database:

(i) Movement of trains (Axle Counter Track Section to Axle Counter Track Section with timing).

(ii) Operator's commands to the Train Describer System.

(k) System will display crew details from the detailed link available in crew management software.

(l) The TMS shall exchange the Train ID and associated information with TMS provided in other sections of EDFC as per details given under Para 2.3.10(4).

(3) **Timetable management**

(a) The TMS system shall support the Timetable Management function so as to provide the information basis for the operation of the system during traffic hours. The Timetable Management function shall provide facilities for:

(i) timetable editing;

(ii) storing and managing different timetable versions;

(iii) Loading of the appropriate timetable and creating an operational timetable.

(b) The Timetable Management functionality shall normally be operative from the TMS provided in EDFC Phase 1 by having TMS under this contract sharing all relevant databases of TMS of EDFC Phase 1. However the TMS shall also have provision of its own Timetable Management functionality provided for the section covered in this contract required for use as per operational requirements.

(c) The TMS shall have capability to receive/send necessary Timetable data from/to TMS provided in EDFC Phase 1. The related database shall be shared by this TMS with TMS of EDFC Phase 1. The contractors shall interface and jointly agree on the format and protocols for data exchange as per Para 2.3.10 (4) of this specification.

(d) The theoretical timetable shall be created by an offline tool provided in TMS. Each train shall be assigned a unique Train Number and each train shall be defined with "time", "location" and "dwell time" to identify start, finish and stopping for each section of the journey. The successfully created timetable files shall be uploaded in the TMS databases as required. It shall be possible to edit/modify the generated time table and test it on simulator terminal before loading it in the TMS system.

(e) The System should be able to automatically generate daily Time Table based on forecast of trains. Once the train enters the EDFC system, the system will generate a revised Time Table taking into account current train running, including any incidences of system degradation.

(f) The timetable format and the daily timetables shall be submitted for the Engineer's approval.

(g) The loading of the appropriate daily timetable shall be initiated automatically on a daily basis, at a specific point in time.

(h) The system shall also enable the operator to load a new daily timetable manually.

(i) The timetable software shall automatically perform the reforecasting of the future train trips when modifications are being performed either by the operator or due to traffic perturbations.

(j) The System shall allow the time of loading to be reconfigured by the Software Technician.

(4) **Train Graph Function**

(a) The Train Management System shall also include Train Graph function for plotting and display of Train Graph. These Train Graphs shall be available at TMS Terminals provided with Chief Controller, Dy. Chief Controller and Traffic Controller(s).

(b) It shall be possible to create, modify and delete Controlled Area included in Train Graph from individual TMS Terminals.

(c) It shall be possible to edit the timetable graphically from the Train Graph display by drag and drop operations.

(d) Train Graph shall plot Time on X-Axis and Stations on Y-Axis. It shall be possible to define and modify scales of X and/or Y coordinates from individual TMS Terminals. The Train Graph Lines/Train ID Box shall have tag with details of train, crew etc.

(e) It shall be possible to show Schedule Time and the Actual Time in the same graph but with different colours.

(f) The Train Distance Graph shall allow for comparing the theoretical and the actual timetable.

(g) The Train Distance Graph shall highlight traffic conflicts and shall assist the regulator in identifying and implementing solutions to resolve conflicts.

(h) The system shall detect and resolve the following conflict situation: Same platform use, same route use, incompatible routes use, and same section use between two stations.

(i) It shall be possible to define and modify colour/image/numbers allotted for various type of Train Loads.

(j) On clicking/selecting a particular train on Train Graph, it shall give complete information about the train viz. Train ID, Crew Details, Load Details (e.g. Container, Petroleum Products, Food Grains, Coal etc.).

(k) Advance Charting: In case Controller defines the Maintenance Block on particular line for particular time, Train Management System shall be able to prepare Projected Train Graph showing advance/predictive movements of available trains in particular section.

(l) It shall be possible to deduce average speed of trains between any two stations.

(m) It shall be possible to take train frequency reports from the time table data base.

(n) It shall be possible to plot Historical Train Graph for selected period for analysis.

(5) **Event log and Alarm management**

(a) All important events such as command, indications, errors, system information, incidences etc. shall be logged in a database for record and analysis.

(b) An Event Logging function shall be implemented enabling the continuous record of all changes of state of the TMS system for maintenance and engineering purposes.

(c) The events (changes of indications, input of commands, alarms etc.) shall be time stamped to an accuracy of one second and recorded in the order of occurrence on a non-volatile media.

(d) The Event log storage capacity shall be initialized and the oldest events shall be overwritten by new events as they occur. Manual archiving by the operator shall also be possible.

(e) When the event storage capacity of the system is reached its content shall be automatically archived without affecting the normal operation of the system. This shall be prompted to the operator by a message.

(f) The Event Log should be automatically backed up by the system with a 60 day archive back up and that the active storage period is a rolling 30 days period.

(g) The Event log shall not be corrupted by power supply or system failure (other than of the event logging sub-system itself).

(h) Event logging shall enable quick and accurate review of past events and provide a concise picture for subsequent analysis in the event of an incident.

(i) The HMI shall support interactive functions for the viewing and processing of events. All events shall have a possibility to be directed to a printer and to archive by different criteria.

(j) The TMS system shall support the generation, display and processing of specific events related to the performance of the Signalling and Train management system.

(k) Alarms can be traffic related and can also be differentiated depending on the criticality of their impact and the action required by the user to resolve or acknowledge a specific alarm. As a minimum, the TMS system shall support three classes of alarms, as follows:

(i) Emergency, i.e. alarms with highest priority, which require acknowledgement and an action to be taken by the operator;

(ii) Urgent, i.e. alarms with medium priority, which only require an acknowledgement;

(iii) Non-urgent, i.e. alarms with low priority, which are for information only.

(l) The Contractor shall propose for the acceptance of the Engineer lists of events that shall be identified as emergency, urgent and non-urgent alarms.

(m) The alarm class shall determine the manner in which the alarm is enunciated, displayed and logged. Alarm parameters should be modifiable at the Software Technician's Console and the classification shall be approved by the Engineer.

(n) Alarms shall be displayed to the operator in a clear and consistent way, which shall be guaranteed to bring his attention.

(o) Following Traffic Related Alarms shall be recorded and displayed on TMS Terminals of Traffic Controller, Signal Fault Controller and concerned Station Master:

(i) Failure of any Signalling Equipment including Electronic Interlocking, Power Supply, Axle Counter, Signal Lamp, Point Machine etc. in the entire section under scope.

(ii) Routes not released after passage of train.

(iii) Train passing Signal at Danger (SPAD).

(iv) Train Non-Descript Alarm (NDA).

(v) Train waiting for more than 5 minutes at a manual stop signal not taken off.

(vi) Train stopping at OFF signal for more than 5 minutes.

(vii) Any other unscheduled train stoppage.

(viii) Any unscheduled train detention in excess of prescribed time.

(ix) All the above Traffic Related Alarms shall be arranged in priority levels to be decided in consultation with the Engineer.

(x) It shall be possible to prepare Traffic Related Alarms Reports in formats to be decided in consultation with the Engineer.

All alarms not directly related to traffic operations shall be considered to be Network related alarms. Failure of Network Communication / inability to access any of the TMS nodes, defective terminals and hardware & software failures shall initiate Network related alarms. These Network Related Alarms shall be displayed on the TMS Maintenance Terminal in OCC. These shall be arranged in priority levels to be decided in consultation with the Engineer.

(p) The user should be able to acknowledge, delete and retrieve alarms.

(q) The operator shall be able to acknowledge alarms individually or by a group. When the operator acknowledges an alarm the TMS system shall log into the Events Log and the Alarms Log a message containing the operator ID, the alarm identification and the time of acknowledgement.

(r) No alarm logging information should be lost due to communication faults or processor failures.

(s) Facilities shall be provided for all alarm messages to be logged into the Events Logs and/or a separate Alarms Log and to be archived.

(t) The TMS shall be able to respond to any query for alarm logs from TMS of other sections of EDFC, whenever required. The TMS shall be able to exchange the data with Central servers of other TMS for the same.

(6) **Crew Management**

(a) The Crew Management functionality shall normally be operative from the TMS provided in EDFC Phase 1 by having TMS provided under this contract sharing all relevant databases with TMS of EDFC Phase 1 or from Crew Management system of IR through FOIS interface. However the TMS shall also have provision of its own Crew Management functionality provided for the section covered in this contract.

(b) The TMS shall provide the Crew Management System functionality for the management of crew running on Deen Dayal Upadhyay-New Bhaupur section of EDFC. Terminals of Crew Management System shall be provided at Crew Control Lobbies/Crew Booking points. In addition some functions of Crew Management System shall be available in TMS Terminals of Chief Controller, Dy. Chief Controller, Traffic Controller and Station Master.

(c) The Crew Management System shall give real time position of Train Running Crew with details of Train and Location.

(d) The Crew Management System shall have provision for creating database records of Train Running Crew. The database records for train crew shall normally consist of fields like crew member name, emergency contact (phone, mobile number), qualifications etc. The database shall also have all the information related to Personnel, Safety and training (like refresher due) of all Train Running Crew. It shall be possible to import crew data in a predefined file in the TMS system format as agreed with the Engineer.

(e) As a part of the Crew Management functions, the crew operator shall have the following operations

(i) Create, add, remove and modify the crew member database

(ii) Create plan that associate On duty crews to generate a Link programme based on data fed for Train Running crew for a predefined period of time ahead

(iii) Modify the above plans before start of daily operations based on crew members availability

(iv) Modify the above plans on abnormal incidences like train delays

(f) The System shall be able to import a roster plan. Roster plan shall associate Duty No. to every trip, provide the sign on/sign off time, break time & counselling time for each duty no. System shall also check for any conflict in the duty no. with respect to trips.

(g) The System shall give crew suggestions, based upon agreed parameters, for the upcoming trips in case of delay in the train running or train reformation; and shall also allow the change manually.

(h) The System shall have provision to enter Train Running Crew Booking Details manually at Crew Control Lobby/Crew Booking Points for predefined period ahead. Deviation for the booking schedules shall be entered by Crew controller on train to train basis. It shall also be possible to change the names of Train Running Crew, when prompted to do so by Central Server.

(i) The System shall also have provision to generate a Link Program based on data fed for Train Running Crew. It shall be possible to change Train Running Crew booking details for next 24 hours as shown in the generated Link Program.

(j) The TMS shall automatically take the Train Running Crew details from the Link Program (with suitable tag that data is from link table) or the online data fed by Crew Controllers at Crew Control Lobby/ Crew Booking Points.

Getting daily report of planned booking and actual booking of Train Running Crew shall be possible. Generation of Monthly Reports of individual Crew in terms of daily KMs, Duty Hours, train on time performance etc. shall be possible based on real time data from TMS. It shall be possible to get driving report for individual running crew. The various Report format shall be finalized in consultation with the Engineer.

(k) The Crew Management System must be closely integrated with TMS to reap the benefits as indicated in paras above.

(l) The Crew Management System Screen shall be menu driven with multiple windows. The details of screen and procedure shall be decided in consultation with Engineer.

(m) The TMS shall be required to send/receive the details of the Crew management information with the Central servers of TMS of EDFC Phase 1 or server of Crew Management system of IR through FOIS interface. The format of the exchange shall be jointly agreed between the Contractors.

(7) **Management Information System**

(a) The system shall generate report of trains running late by pre-prescribed reference.

(b) Based on the events logged and the operator input, the system shall generate the following (but not be limited to) reports:

(i) Punctuality report - daily, weekly or monthly as per prescribed format.

(ii) Bad runner report.

(iii) Train Composition report.

(iv) Analytical report of various unusual occurrences, i.e. Signal failures, OHE breakdown, Loco failure, Sick wagons etc. This can be again generated on daily, weekly or monthly basis on prescribed format.

(v) Analytical report of crew link/ utilization.

(vi) Total Maintenance Blocks granted / refused along with locations, time blocked, time cleared.

(vii) Sectional running time taken by trains of any ID.

(viii) Delay report of trains along with train Nos., time delayed (at stations/mid-section) etc.

(ix) Difference between actual and scheduled running time in tabulated as well as in graphical form.

(x) Loss on account of imposition of speed restrictions.

(c) The system shall allow user to create an unusual report, describing a failure and the trains that were affected by it.

(d) The system shall allow user to enter any free text tag to be associated with any train.

(e) The reports shall be generated in designated formats.

(f) Report formats shall be customizable.

(g) Provision shall be made for the basic data reports to be exported to other systems in different formats so that they can be represented as necessary.

(h) The TMS shall be required to send/receive the details of the Management information system reports with Central server(s) of TMS of other sections of EDFC as per Para 2.3.10 of this specification. The format of the exchange shall be jointly agreed between the Contractors.

(8) **Simulation and Training System**

(a) Separate Servers and terminals shall be provided for Simulation studies, Playback, and Training purpose at OCC. The replay of log, training to operators, time table testing etc. shall be possible from these terminals and associated servers.

(b) It shall be possible to test generated/edited Time Table on Simulation System Software.

(c) Simulation System shall be suitably integrated with TMS Central Server for transfer of the tested Time Table. This transfer shall be possible by authorized user only.

(d) Through Simulation System Software, it shall be possible to simulate and observe the effect of various parameters such as Maintenance Block, Speed Restrictions, Change in Yard Layouts, Addition/Deletion of Signal, Train speed, Dwelling Time etc. on Section Capacity and to produce effected Working Time Table and Train Graphs. These parameters shall be determined in consultation with the Engineer.

(e) Simulation System Software shall facilitate simulation of train movements by occupying & releasing Axle Counter Track Sections in accordance with movement of trains.

(f) Simulation System shall be suitably integrated with TMS Central Server and its Database for downloading a copy of Events Logs & Alarms for predefined/selected duration in its own Database.

(g) The simulation of downloaded Events Log & Alarms for replay shall be possible. This simulation shall be possible in real time or in reduced/accelerated time scale. When the replay is started, the dynamic status for infrastructure, Train ID, Alarm List as well as the pictures on the screen shall be initialized. It shall be possible to perform studies on this simulation by changing various dynamic parameters such as Speed Limit on Signals, Temporary & Permanent speed Restrictions, Braking Characteristics, Driver's Reaction time etc.

(h) The Simulation System Software shall be capable of simulating the existing Time Table and compare it with actual running on periodic basis to create

Management Information to identify any shortcomings in the System/Time Table.

(i) Simulation System shall also be used for imparting training through terminals provided to Trainer and Trainees. Details of facilities and features available on these terminals shall be decided in consultation with Engineer.

(j) It shall be possible to configure Trainer's terminal to work as active Traffic Controller's TMS Terminal in case of any of the Traffic Controller's TMS terminal becomes defective/out of service.

(k) The Playback functionality shall be provided to truly reproduce what has happened on the real application during a definite time period in the past. By means of the playback it shall be possible to replay what has happened and analyze the different situation in terms of both system behavior and Section Controllers operations. The playback reproduction shall be possible from any workstation on which playback functionality is available.

2.3.3 System Architecture and Design Requirements

(1) The TMS system architecture shall be defined in conjunction with the type, architecture and design of the vital Interlocking System(s) and the designated interlocking areas.

(2) The architecture shall utilize local intelligent units, coordinated by a central computer with highly reliable and redundant communication channels.

(3) While the interlocking system(s) and the TMS will be closely interrelated from an operational point of view they shall have clearly defined interfaces so as to eliminate any possibility of a failure in one of the interfacing systems causing a malfunction or affecting the performance of the other.

(4) The interfaces shall be so defined to:

(a) Enable the TMS system to operate at high levels of functionality with minimal risk to safety;
(b) Enable to keep to the minimum the complexity of the vital interlocking system;
(c) Facilitate validation, testing and fault finding.

(5) The Train Management System shall, broadly comprise of, but not limited to, the following:

(a) Central Server(s) at OCC.
(b) Simulation Server(s) at OCC.
(c) Communication network and Communication front end server(s)(Optional) at OCC.
(d) Video Wall Display System at OCC for Signalling and SCADA.
(e) TMS Terminals for Controllers at OCC.
(f) Terminals for Simulation, Time Table Planning and Maintenance at OCC.
(g) TMS Terminals for Station Master at Stations.
(h) TMS Terminals for Maintenance at Station, IMD & IMSD.
(i) TMS Terminals for Crew Management.
(j) TMS terminals for Miscellaneous Users.
(k) Communication Network & Way Side Communication Equipment at Wayside EI.
(l) TMS System Software.
(m) Printers, Plotters, Cables, Connectors and other accessories.

(n) Interfacing arrangement with Traction Power SCADA system.
(o) Interfacing arrangement with Master Clock System.
(p) Interfacing arrangement with TMS of adjacent sections and Backup OCC.

(6) The architecture shall incorporate sufficient level of redundancy to ensure the required availability, as specified under Para 3.6.4 of this specification.

(7) The TMS System shall have inbuilt redundancy in the software and hardware at OCC as well as at the wayside locations including all servers, communication network equipment and links/channels such that a failure of single component of the TMS system does not lead to loss of overall TMS functionality.

(8) The TMS system shall be structured in such way that in the event of a single hardware or software module failure, full system functionality shall be automatically restored upon rectification of fault within such time as to achieve the required system performance criteria.

(9) The TMS system shall be designed to use not more than 40% of the available CPU in normal operation and not more than 60% of the CPU in rush hour,

(10) The TMS system designed and implemented shall be flexible and modular enough to permit easy alterations/changes in terms of change in site data, addition or deletion of user, stations etc. and for easy reconfiguration to take into account future software/hardware developments.

(11) The TMS system is intended to be used in 24/7 mode. Hence built in features/strategies should ensure that the system is available on a continuous basis. Particular care should be taken during system design in selection of components that ensure specified availability for the TMS.

(12) The System shall be designed to achieve the overall objective of providing real time information related to train operation. The response time between a change of state of Signalling equipment at a wayside station and its display at OCC shall not be greater than 2 seconds.

(13) TMS Capacity

(a) The TMS system shall have adequate capacity to handle data for running of 8 trains per hour in each direction during normal operation and 12 trains per hour in each direction during rush hour.

(b) The TMS system shall be designed to have a 20% expansion capability beyond what is specified at (a) above.

(14) Sufficient Memory and related resources shall be provided to enable the implementation of additional displays consistent with the requirements for extension of the system.

(15) There shall be provision of network based printers in OCC for printing various reports and logs. Three numbers of A3 colour laser type printers shall be provided in the OCC. A0 plotter shall be provided for plotting various train charts/graphs at OCC. At every station with TMS terminal one A3 colour laser printer shall be provided. 5 nos. of A3 printers shall be separately provided whose location shall be specified by the Engineer.

2.3.4 Features of TMS terminals

(1) **Common features of TMS terminals**

(a) For standard monitoring, supervision and control purposes all operator interfaces to the TMS system should be through universal type of workstations (TMS terminals) which can be easily configured to required operator functionality based on the users log in profile. Irrespective of whatever may be the operational role of user, the TMS terminals shall have the same look and feel to maximize the operational synergies between the various operator roles.

(b) All the TMS terminals shall show the real time display of train movements and status of Signalling infrastructure.

(c) All user initiated functions shall be accessible using Mouse & Key Board. It shall be possible to enter commands through menus, selection in the pictures, functional keys or via text input through GUI based user-interface. The precise operation of objects and the content of menus must be as agreed with the Engineer.

(d) It shall be possible to scroll from left to right and vice versa from one station to another without flicker. In case of big yards with a number of lines, the yard shall not look congested on the screen. In addition, it shall be possible to divide the bigger yards into suitable no. of pictures.

(e) It shall be possible to open many windows on each terminal. A window must be active when the cursor is moved in its frame and the operator must be able to issue commands only to those objects in active window. The display shall be dynamic even if the related window on the screen is not active.

(f) The various input displays and reporting formats (to be decided in consultation with Engineer) shall be used for dialogue between the operator and the terminal.

(g) It shall be possible to mute the audio or change the volume. It shall be possible to alter the viewing angle of the VDU monitor in the vertical and horizontal planes.

(h) Current time and date shall be continuously displayed on the VDU screen conspicuously. Furthermore, the display shall be provided with an indication, which ensures the VDU screen is communicating in real-time and is not “frozen”

(i) In case of unusual events, the system shall prompt the controller to enter the reason and other details in the prescribed format. This shall form part of database and shall be used for MIS reports later.

(j) Any failure or unusual event will generate an audio/visual alarm as per user requirements to draw attention of the operator. It shall be possible to acknowledge and stop the alarm of failures by the user.

(k) Authority to log in shall be protected through a password. Only authorized persons shall be able to log in and access related database.

(l) Access to the server’s application software & system software shall be restricted through the gateway and proper authority check.

(m) The Contractor shall to the extent possible design the user interface of the TMS terminals, similar to the user interface of TMS terminals provided in EDFC Phase 1.

(2) **Specific Features on various TMS terminals**

(a) **TMS Terminals for Controllers -Chief Controller, Dy. Chief Controller, Traffic Controller(s) and Assistant Controller**

(i) These TMS terminals with each of the Controller shall have three monitors, one will show the overview, another detailed view and the third one would show the alarm/event view. There shall be full flexibility, however with regard to display of information on any of the 3 monitors.

(ii) TMS Terminal shall facilitate all functions of Train Describer System as mentioned section 2.3.2 (2).

(iii) All the Traffic related alarms described in section 2.3.2 (5) shall be available on these terminals.

(iv) The crew details available in the system shall also be available on these terminals, apart from being available on the TMS Terminals of Station Masters and Crew controllers.

(v) It shall be possible to view Train Graphs be it historical, previous or current. The Train Graph shall also cover advance charting showing traffic blocks. Messages/Information of diversion/cancellation of trains issued from these Terminals will draw attention of SM by flashing audio visual indication.

(vi) The Traffic Controller shall be able to enter any inputs regarding rescheduling of trains. This data shall be considered temporary and the operator shall be prompted to input the duration for which the data shall be held valid.

(vii) The temporary valid data shall be given the same status as that of permanent data and all the time tables and trains graphs shall be generated as per this data.

(viii) It shall be possible to view various MIS reports.

(b) **TMS Terminal for Signal Fault Controller at OCC**

(i) Remote monitoring of status of Signalling equipment at stations and in Block Sections, shall be provided on these terminals. This shall include logging in of events in central system, generating alarms, alerts etc.

(ii) Signalling equipment failure alarms as decided by the Engineer along with category shall be available on the terminal. It shall be possible to acknowledge the alarms by the user.

(iii) All Traffic related alarms also shall be available on these terminals.

(iv) It shall be possible to gain access to all reports as can be accessed by the Traffic controller(s).

(v) All the formats for the displays /reports shall be decided in consultation with the Engineer.

(vi) It shall be possible to send message to the other controllers through the terminal by video flash /audio buzzer.

(vii) Facility of viewing the train graph on the same monitor shall be available on these terminals.

(c) **TMS Terminals for Track Controller and Traction Power Controller at OCC**

(i) It shall be possible to input remarks / information pertaining to various unusual occurrences e.g. failures & delays to operation etc.

(ii) It shall be possible to gain access to all reports as can be accessed by the Traffic controller.

(iii) It shall be possible to access the Central server for retrieving reports in suitable format. All the formats for the reports shall be decided in consultation with the Engineer. System will have a provision that a report retrieved by a particular controller pertains to him only.

(iv) It shall be possible to send message to the other controllers through his terminal by video flash /audio buzzer.

(v) Equipment failure alarms specific to Track or Traction Power, as decided by the Engineer along with category shall be available on the respective terminals.

(d) **TMS Maintenance Terminal at OCC**

(i) The Maintenance Terminal shall be used for supervisory functions of the network and for observing any required nodes and their configuration at any time.

(ii) It shall be used for indication of all alarms, both operator related and network related.

(iii) It shall be possible to bypass any node if so required and configure other terminals from this terminal.

(iv) It shall have fault logging & diagnostics for network equipment at element level.

(v) Displays of equipment faults, communication failure occurring anywhere in the OCC or field network shall be readily available on this terminal.

(vi) In case of faults, this terminal shall provide all assistance for rapid detection of faults.

(vii) Alarms shall be available on this terminal as per categorization in 2.3.2 (5) and few of the Emergency Alarms are as follows:

- Power supply failures at control centre, station, block section location or any node in network.
- Central control internal communication failure.
- Communication equipment failure.
- Field control unit failure.
- Failure of nodes.
- System failure.
- Interlocking interface failure (Way Side Communication Equipment).
- Any other indication considered essential by the Employer.

(viii) Alarms shall be logged on real time basis. These shall be recorded in format so as to access particular file as required at a later date.

Exception report (failure report of desired elements) shall be generated. File format shall be decided in consultation with the Engineer.

(ix) This terminal shall have access to MIS reports.

(x) Terminal will provide a pop up window to display a table to allow maintainer to correlate data communication with its associated field objects. Also, online display about the following shall be available:

- Station being polled.
- Station transmitting.
- Station faulty.

(xi) Element level Network Management System (NMS) module shall be available on this terminal and shall show:

- The position of various nodes.
- Identification of faults and their nature.
- Current status and health of equipment and communication channels.
- Memory utilization.
- Remote bypassing and changeover of faulty equipment.
- Ability to check quality of communication from any node to the other on the network including bridges and routers. This shall be done in background without visibly downgrading the system.

(xii) Facility to view system / network performance statistics on this terminal shall be provided. From this terminals other work station computers, terminal servers, voice and data switching nodes and SM terminals shall be able to be monitored at element level for performance and switching to alternate communication channel.

(xiii) It shall be possible to monitor all elements of network of OCC and field units through NMS.

(xiv) SNMP or a similar standard protocol as approved by the Engineer shall be used.

(xv) It shall have facility for real time diagnostics of Communication network automatically as well as manually.

(xvi) Facility for Network performance statistics, communication testing and managing internal or external node on the network shall be made available.

(xvii) Fault Diagnostics

- All malfunction in vital hardware subsystem/ modules in the OCC shall result in audio & visual alarm at the maintenance terminal.
- The maintenance terminal shall have diagnostic software through which it will periodically scan all elements.
- Diagnostic routine to check hardware like TMS field equipment (excluding interlocking installation) and data communication circuits shall be available.
- Shall have monitor programs to test connectivity.

- Facility shall exist in the system to switch from one communication line to the other in case of fault.
- It shall be possible to display polling status of stations.
- It shall be possible to capture all transmission events for analysis and fault finding of data transmission.
- It shall be possible to change the password configuration of the Controllers /SMs terminals.

(e) **TMS Terminal for Station Master at Station**

(i) One TMS Terminal for Station Master at every Station shall be provided.

(ii) TMS Terminal for Station Master shall facilitate all functions of Train Describer System as mentioned in Clause 2.3.2 (2)

(iii) It shall be possible to query the system regarding details of trains, cancellation, rescheduling, delays, diversions, siding occupancy etc. either through menu driven commands or through SQL commands.

(iv) The details of occupancy of berthing lines and sidings shall be available. Details of loads available on sidings at concerned station shall be displayed when cursor is placed on the siding. Whenever a train leaves / enters the control area or is put out of the system by placing it in the siding it shall be automatically registered by the system. In addition to this, SM shall have facility to delete / enter such trains. Whenever a train / load leaves /enters the control area of concerned station or is put out of the system by placing it in the siding the SM shall have facility to delete / enter such trains from / into the system.

(v) Flashing messages/instructions from the controller and information about expected arrival of next two trains on each line, cancellation and diversion of trains shall be displayed.

(vi) It shall be possible to view various MIS reports.

(vii) Communication arrangements available at the station shall also be displayed symbolically.

(viii) It shall be possible to send pre-defined routine messages by the Station Master to Central server either pre-stored or entered through a dialogue box.

(ix) Crew details information shall also be available with these terminals.

(f) **TMS Terminal with Signal Maintainer at Station, IMD and IMSD**

(i) The alarms for failure of vital Signalling and Power Supply Equipment in the jurisdiction of Station, IMD and IMSD shall be available on the terminal.

(ii) Traffic related alarms shall also be available on these terminals.

(iii) It shall be possible to view various MIS reports as agreed to by the Engineer during design stage.

(iv) Facility of sending the messages to Central controllers including the signal fault controller shall be available on these terminals.

(g) **Miscellaneous User Terminal**

The Contractor shall provide 15 Nos. of Miscellaneous User TMS Terminals at important offices/locations. The locations will be IR stations, IR Divisional and Zonal office and DFCCIL Regional & Corporate office etc. as decided by the Engineer. The exact locations and features to be made available on these terminals shall be approved by the Engineer. These terminals will provide first-hand information about running of trains in visual form and in required format. While the terminals provided in the DFCCIL territory will be connected on Telecommunication System being provided under PS (Telecommunications) Vol. 8, Section V(B), Part-2, for the terminals provided in the IR territory, network and requisite Power Supply if available shall be used by the contractor.

2.3.5 Software Features and System Administration

(1) As all data may not be available in a satisfactory format during the initial implementation of the system, it is necessary that provision exists for incorporating changes/amendments to the existing formats/presentation and for introduction of any new functionality. It is also possible that additional items/objects may have to be introduced in future, hence provision should exist for incorporating such items/objects.

(2) Modification and Alteration

(a) It shall be possible to add minor additional functionality (to be decided in consultation with the Engineer) or even extend the system to increase number of users by adding additional workstations without changing existing software.

(b) Following modifications shall be possible with password authentication without recourse to the source program (code).

(i) Managing the Users

- Ability to add users specifying their names, password & access level.
- Facility to delete an existing user.
- Change the priorities allocated to users.
- Stop / provide access to any of the modules.
- Change areas of jurisdiction.

(ii) Database Management

- Database administration.
- Edit database to change the names of locations, stations etc.
- Change status of stations.
- Introduce new stations.
- Introduce new objects and delete existing objects.
- Change details of objects.
- Amend / alter geographical layout at stations and in between stations.
- Change format of reports.
- Introduce new reports.
- Introduce/change/delete temporary speed restrictions.

(iii) Time Table Management

- Cancel a train.
- Insert an additional train.
- Change the destination of a train.
- Change the departure time of a train.

- Change the timetabled dwell time at any station for one train or all trains.
- Change timings of existing trains.
- Change the sequences of trains.
- Change various particulars of trains.
- Change the loco number vis-à-vis train number.

(iv) System Management

- Change priorities of existing alarms.
- Introduce new alarms with varying priorities.
- Changing the details of any node.
- Introduction of new nodes.
- Changing the displays on maintainer's terminal.
- Changing the printer / plotter parameters.

(3) System Administration

(a) A supervisor administration function to be exercised by a single nominated person shall, as a minimum, be available to control the following:

(i) Allocation of Passwords.
(ii) Creation and deletion of Users.
(iii) Administration and housekeeping functions.

(b) Functional and geographic partitioning shall be possible for different user profiles. The TMS shall have provision for following configuration changes :

(i) It shall be possible to partition the TMS system on multiple levels to control distribution of alarms and events and to provide security.

(ii) Partitions shall be used to determine if a particular alarm or event is routed to a specific MMI user and to validate if that user can execute a control or function.

(iii) The system shall support the division into functional partitions. Each functional partition shall represent a function such as Traffic Controller, Station Master etc.

(iv) The system shall support the division into geographic partitions. Each partition shall represent a geographically related group of assets.

(v) Each indication, control, alarm and user action shall be assignable to any one or multiple functional partitions.

(vi) Each indication, control, alarm and user action shall be assignable to one geographical partition.

(vii) Functional and geographical partitioning shall be assigned by TMS to a user based on logon information.

2.3.6 Technical Requirements

(1) **General**

(a) All Servers and Terminals to be provided at OCC shall be of same type and make as approved by the Engineer.

(b) All Terminals to be provided at wayside locations shall be of same type and make as approved by the Engineer. The hardware installed at wayside locations shall be modular and rugged and of appropriate size, capability and capacity.

(c) All Servers and Terminals at OCC & wayside locations shall be provided with printer slot and minimum 2 spare I/O slots for future use.

(d) Servers and Terminals shall be of Industrial grade. Vendor of Servers and Terminals shall have service centres in India.

(e) LED Indications and test points shall be available on various cards /Modules for easy fault diagnostics by the maintenance personnel.

(f) Field station hardware shall be housed in a 19" dust free, pre-wired rack.

(g) The system designed and implemented shall be flexible and modular enough to permit easy alterations/changes in terms of change in site data, addition or deletion of user, stations etc. and for easy reconfiguration to take into account future software/hardware developments.

(h) The TMS system shall support communication with neighbouring TMS based on UIC 407-1 or similar standards.

(2) **Central Server(s)**

(a) The following shall be the main functions of the Central server(s):

(i) It shall maintain and update in real time the position of all the TMS indications /information / all field nodes to the last second.

(ii) It shall provide drive for the Video Wall Display Panel. It shall display all the incoming information /data and shall revert back to the field nodes for incomplete information to ensure the latest information is obtained.

(iii) It shall accept input data from the authorized operator /node only. The access to the server shall be through a gateway with the correct level of authority. It shall process the data as per requirements of the system.

(iv) It shall reply to the queries requested by various SMs in the background without interrupting the Traffic Controllers.

(v) It shall provide necessary data to print the various reports in suitable formats.

(vi) It shall enable display of both information and alarms on any of the terminals in OCC, Station etc. as per pre-programming.

(vii) It shall be connected via data channels with the entire station signal interlocking through a suitable interface. The OFC/data channels for connectivity will be provided under PS (Telecommunications).

(viii) The aggregate information/ status of Track sections, signals, points, route set, LC gate closed/open etc. of station and block section shall be transmitted from wayside stations to Central server.

(ix) The Central server(s) shall also be interconnected to Central server(s) of EDFC Phase 1 for exchange of necessary data as per the interface agreements between the two contractors.

(b) The Contractor shall propose their own networking methods between field stations and Central server to achieve desired performance. All network elements shall be capable of being monitored and managed in the event of malfunction.

(c) It shall be provided with adequate flexibility so that alterations and additions to the present functions and facilities are carried out with minimum

disruption in the working system as and when required. It shall be compatible with future interlocking changes/yard alterations at wayside stations.

(d) It shall be compatible for running off line forecasting module for computing expected arrival of trains.

(e) Central server equipment shall be fault tolerant system. It shall also be provided with Disc storage device to store real time database reflecting TMS information as well as an event logging database. Various terminal / equipment in the OCC office shall be interconnected with applications server using a dual local area network (LAN). Adequate redundancy of critical system, software and database shall be ensured.

(f) Central server shall have following minimum hardware configuration:

(i) Type: High end server.
(ii) Processor – Minimum 64 Bit, Multi Core Multi processor.
(iii) Speed - Minimum 2 GHz.
(iv) N+1 hot swap cooling.
(v) PCI-X 8/16 port.
(vi) Core PCI-X dual port 10/100/1000Base TX LAN (with auto speed sensing; RJ 45 connector, Wake On LAN support).
(vii) HDD - Minimum 8X146 GB, Hot swappable, Ultra SCSI with appropriate RAID configuration support.
(viii) Console - 32” colour monitor.
(ix) Hot swappable redundant power supply.
(x) I/O card - Adequate I/O facility.
(xi) Accessories - As required.
(xii) Supporting operating system – 64 bit
(xiii) Server shall be mountable on 19” rack.
(xiv) The hardware requirements described above are minimum requirements but are not definitive. The Contractor shall design and supply all hardware to fulfil all functionality, reliability and availability requirements as specified.

(g) The number of Servers and their configuration should be proposed by the Contractor. The Contractor must present RAMS analysis in order to demonstrate that the proposed solution satisfy the availability requirements.”

(h) Central Server shall be provided in hot standby mode. The Standby server shall be exact replica of Main Server. In the event of problem with Main server, execution of application shall be seamlessly transferred to Standby server without interrupting the operation and affecting the quality of service of operation. Similarly, if system is running on Standby server and it fails, working shall be transferred to Main server. Central Server shall be capable enough to deliver the required performance. It shall be possible to disconnect the Standby server for repair/replacement without affecting the server in operation. The contractor may supply more than one equipment/set of equipment to achieve the required performance along with its hot standby.

(i) Logging of Data on Servers

Following data need to be archived for subsequent use:

- All train related information. (Signalling indications, train movements details, trains description details etc.)
- All system related data viz. node failures, hardware failures, communication failures etc.
- All inputs made by the way side terminals (inclusive of crew lobby/crew booking point) or by terminals at the OCC.
- The data shall be stored in a compressed and organized form so as to conserve the disc space.
- The storage shall be for a minimum period of 60 days.
- It shall be possible to take INCREMENTAL back up on hard disc. The Contractor shall provide additional hardware for this purpose.
- It shall be ensured that the data is not lost while copying.
- The notes recorded by the Section controllers/SMs shall also be logged on the storage devices. These notes shall be linked to the concerned screen and context.

(3) **Simulation Server**

(a) This Server shall be provided as a separate Server with its own LAN at the OCC or any other location as decided by Employer for training and simulation purposes as per following (but not limited to) details:

(i) One terminal with 3X32" (minimum) VDUs for Simulation and Time Table Planning.

(ii) Five terminals for Trainees with 1X32" VDU (minimum).

(iii) HDD - Minimum 2 X 64 GB, Hot swappable, Ultra SCSI in RAID 1.

(iv) It shall be possible to configure Trainer's terminal to work as active Controller's terminal in case of any of the Controller's terminal becomes defective/ out of service or any other reason.

(v) The hardware requirements described above are minimum requirements but are not definitive. The Contractor shall design and supply all hardware to fulfil all functionality, reliability and availability requirements as specified.

(b) It shall be possible to access the database for analysis and simulation studies. The data or results thus generated after simulation study or analysis shall not be stored on the main memory of the Central server permanently. To prevent the same, both hardware and software checks shall be provided. It shall be possible to store it in its own hard disc.

(4) **TMS Terminals Hardware**

(a) All TMS terminals shall have similar hardware configuration. Following Hardware Configuration shall be proposed :

(i) Type: Industrial Workstation.

(ii) Processor: 64 Bit Multi Core Multi Processor.

(iii) RAM: Minimum 8 GB.

(iv) FLASH MEMORY: Minimum 120 GB.

(v) Monitor: LED Backlit Colour monitor, high resolution 1920 X1200,

(vi) I/O card: Adequate I/O facility, Integrated Drive Controllers, Dual network Interface cards, High End Graphics card etc.

(vii) Accessories: As per requirement.

(viii) A printer shall be connected for on line logging with the TMS Maintenance Terminal for logging all network related alarms.

(ix) The hardware requirements described above are minimum requirements but are not definitive. The Contractor shall design and supply all hardware to fulfil all functionality, reliability and availability requirements as specified.

(b) Table below shows the various operational posts for which the TMS terminals are provided and the number and sizes of monitors with the controllers.

Operational Post	**Monitor Size (inches)**	**No. of monitors per position**
Chief Controller	32”	3
Dy. Chief Controller	32”	3
Assistant Controller	32”	3
Traffic Controller(s)	32”	3
TMS Maintenance Terminal at OCC	32’’	1
Signal Fault Controller	32’’	1
Track Controller	32”	1
Traction Power Controller	32”	1
Station Master at Station	32”	1
Crew Controller	32”	1
Signal Maintainer at Station, IMD and IMSD	32”	1
Miscellaneous User TMS Terminals	32”	1

(c) In the OCC separate workstations for offline timetable management shall be provided having the same configuration as those for TMS terminals.

(5) **Communication Network at OCC**

(a) Dedicated Communication Network at OCC for interconnection of TMS Equipment (Servers, Terminals, Video Wall Systems, Data Storage, Printers etc.) shall be fault tolerant.

(b) Networking Equipment used in Communication Network such as Bridges, Gateways, Routers, Switches and Repeaters shall have redundancy.

(c) The local area network employed shall be Dual LAN Network based on FDDI/Ethernet/Serial communication.

(d) Dual redundant link shall provide highly resilient communications network. System shall be tolerant to multiple simultaneous link failures, maintaining operation without degradation of performance. It shall be possible to perform maintenance on communication links without stopping the Signalling system.

(e) Data transfer to peripherals like printers & plotters can be at lower speed for each device using appropriate media with duplicate path.

(f) For connecting peripherals, screened twisted pair cables shall be used.

(g) The cables used shall be of rugged type with capability to work data up to at least 1000 Mbps.

(h) 30% spare Ports on Switches & Hubs etc. shall be kept spare for future use.

(i) Failure of any single Wayside Communication Equipment shall not cause failure of complete communication of TMS other than that of particular Wayside Communication Equipment.

(j) It shall be possible to interface and transfer the circuits on to the backup communication on redundant OFC, wherever available.

(k) All equipment shall be installed in standard 19” racks.

(l) The time slots working shall have redundancy. However, it shall be possible to transfer all data from one time slot to a redundant time slot, if required.

(m) The transmission with field station shall be controlled by polling wherever transmission is in serial mode and not in star configuration.

(n) In-built safety provisions shall be available to detect data corruption/ non-receipt of packets/node defect problems.

2.3.7 Video Wall Display System

(1) Video Wall Display

(a) The Video Wall Display shall be of rear projection screen (RPS) type based on single chip DLP Technology. It shall consist of RPS Display modules and Display Controller which will integrate various display modules into a single logical Display Wall.

(b) The Video Wall Display system shall be rugged and shall be able to work on 24x7 basis.

(c) The display windows shall be freely resizable, re-scalable and repositionable on any part of the display wall.

(d) Sufficient space shall be made available between the track indications for alphanumeric displays.

(e) Suitable Interface equipment and drivers for linking Indication panel with applications server shall be provided.

(f) The terminal server /driver for driving the Video Wall Display Panel shall have full-fledged capacity to drive described displays from provided equipment + 20% spare.

(g) The placement of Video Wall Display Panels, seating arrangement of the Controller's, viewing angle in vertical and horizontal plane etc. inside OCC shall be carefully planned. To ensure a user-friendly environment, an ergonomic study shall be performed by the Contractor to guarantee uniformity and consistency.

(h) Legibility, lighting, contrast, content, font size, viewing distance etc. shall be kept in view while designing graphics for the display.

(i) Surface shall have matt finish to keep it glare free.

(j) Glass backing shall be used so that there is no screen build bulge in.

(k) Station layouts can be arranged in a number of rows– top, middle and bottom.

(l) The lowest row shall not be below 1.5 meters (approx.) from the floor to ensure proper viewing angle. This shall be got agreed by the Engineer.

(m) Pedestal shall be made of Aluminium extruded and anodized members. Front of the pedestal shall be covered.

(n) It shall be compatible with the international VIDEO Standards.

(o) It shall have high MTBF and low MTTR. Values of the same shall be given with supporting calculations/data.

(p) Rear Projection System shall have rear service access.

(q) Projection system shall have cooling fan with dust filter.

(r) It shall be possible to increase/decrease the colour intensity, contrast adjusting etc. screen wise through the system console. It shall be possible to memorize the parameters of one screen and use the same parameters for all the other screens.

(s) The unit shall be compact and energy efficient so as to conserve on space and power consumption.

(t) The projector support software packages, documentation and details of maintenance shall also be supplied.

(u) Any other facility to make the system more user friendly shall be incorporated.

(v) Indigenous service support shall be available for the selected equipment in India.

(w) The Contractor shall design the Video Display wall of appropriate size to include all functionality required for EDFC-2 (Deen Dayal Upadhyay-New Bhaupur section).

(x) The Video wall system shall be generally similar in appearance to the other Video wall system planned/provided in EDFC Phase 1, so as to have

uniformity with existing system. The Contractor shall interface with the contractor of EDFC Phase 1 for the same during design phase.

(y) The Contractor shall submit the colour scheme to be used for the symbols to be adopted for the Video Display Wall for approval by the Engineer. The Contractor shall also provide a mock-up of the display prior to the commencement of implementation for approval by the Engineer.

(z) Video Wall installed at OCC Allahabad can be used. If any alteration/addition is required, shall be carried out by the contractor.

(2) Minimum Technical Requirements of Display Wall

Item	Specification
Projection Technology	Rear Projection based on Single Chip Digital Light Processing (DLP) technology
Architecture	The display unit/rear projection modules shall have in-built illumination system.
Display size	The diagonal size of each visual display unit/rear projection module shall be minimum 70 inches (Diagonal) - to be got agreed by the Engineer.
Resolution	Each individual cube minimum Full HD (1920x1080 pixels)
Aspect Ratio	16:10 or 16:9
Lamp type	LED – RGB
Display redundancy	The Display Unit/Rear Projection Modules should have in-built redundancy in LEDs for each colour and ensure redundancy at the light source level without any mechanical movement.
	Error shall also be shown by Diagnostic LED indicators in case of LED lamp failure.
Cooling Mechanism	Cooling shall be by means of heat pipe. No pump based mechanism is acceptable due to possibility of failure.
Brightness	Shall be minimum 220cd/m² or higher.
Brightness Uniformity	≥ 95%. To automatically provide brightness and colour stability over time and across the entire display.
Contrast ratio (Full field)	≥ 1400:1
Colour gamut	Better than 100% EBU
Screen	Burn free. No memory and no ghosting. No constant flicker. Low reflection with matt finish.
Screen type	Fresnel/ Lenticular
Screen to screen gap	Shall be adjustable up to 1.0 mm or less for seamless

Item	Specification
	viewing.
Viewing Angle	Full viewing angle shall be 180 degrees.
Pedestals	Shall be customized as per project requirements.
Component input Compatibility	480i, 480P, 720P, 1080i
Auto detection	System shall automatically search the source which has input signal after signal plug- in.
Source Redundancy	System shall be able to switch to secondary DVI input if primary DVI input is not available.
	System shall also automatically switch back to primary DVI from secondary DVI input as soon as primary DVI input becomes available again.
Power control	1AC power ON/OFF switch.
LED indicator	Power LED (Standby: Red, ON: Green, Fan led, Lamp LED).
IP /Remote Control	User should be able to control and monitor each Projection module through Internet / Intranet.
Component Life- LEDs	>60,000 Hours
LED Control	Dynamic control
Startup	Instant hot restart
Component life- DMD Panel	Shall be greater than 650,000 hours

(3) Display Controller

(a) The Display Controller shall be housed in an industrial 19" rack mounted casing (6U) based on Intel Quad Core CPU 2.66 GHz (Minimum)

(b) The Display controller shall have minimum memory of 4 GB.

(c) The Display controller unit shall be equipped with a DVD ROM Drive.

(d) The Display controller system shall be equipped with 500 GB HDD in RAID 1 Configuration.

(e) The Display controller shall be dual redundant with auto switchover including dual redundant hot swappable power supply.

(f) The Display controller shall have 10/100/1000 Mbps Redundant Ethernet port for LAN connection.

(g) The Display controller shall be supplied with a Keyboard and mouse with 20 m cable extension.

(h) The Display Controller shall be based on 64 bit Operating system.

(i) The Display controller shall have the possibility of connecting the various types of analog and digital sources which can be shown in freely scalable and moveable windows on the graphics wall. It shall support minimum 2 DVI/VGA/HDMI Inputs and 8 Composite video inputs.

(j) The hardware requirements described above are minimum requirements but are not definitive. The Contractor shall design and supply all hardware to fulfil all functionality, reliability and availability requirements as specified.

(4) Wall Management Software

(a) The Wall Management software shall provide control and management of application windows and display devices connected with the display controller.

(b) It shall be able to pre configure various display layouts and access them at any time with a simple mouse click.

(c) The software shall enable the users to see the desktop of the graphics display wall remotely on any Windows OS workstation connected with the Display Controller over the Ethernet and change the size and position of the various windows being shown.

(d) The software shall enable various operators to access the display wall from the local keyboard and mouse of their workstation connected with the Display Controller on the Ethernet.

(e) The software shall copy the screen content of the workstation connected on the Ethernet with the Display Controller to be shown on the Display wall in scalable and moveable windows in real time environment.

(f) The wall management software shall support open APIs to enable system integrators to integrate it with their Software.

(g) The Diagnostic software shall perform health monitoring that allows timely detection of faults.

(i) Wall health.

(ii) Cube health.

(iii) Cube IP-address.

(iv) Brightness.

(h) The software shall support control of brightness, contrast, saturation, hue, filtering, crop and rotate function on the various displays connected to the display controller.

(i) The integrated view shall provide a database that:

(i) Records all events.

(ii) Can record full status at given time intervals.

(iii) Can be exported to EXCEL/HTML; and

(iv) Show internal patterns.

2.3.8 Wayside Communication Equipment

(1) Wayside Communication equipment at Electronic Interlocking shall be provided with redundancy for meeting communication requirements between Wayside

electronic Interlocking and Servers at OCC. It shall provide interface with the Potential Free Contacts of relays used in Signal Equipment Room.

(2) These units shall be installed in Signal Equipment room. 20% of the slots used for fixing I/O and peripheral cards shall be kept spare for future expansion.

2.3.9 Software Requirements

(1) The TMS software shall be developed conforming to the requirements specified in EN 50128 or other international equivalent standard for Safety Integrity Level 2 (SIL 2).

(2) The Software shall be designed, developed and tested according to the Software Quality Assurance Plan. The Contractor shall define within the Software Quality Assurance Plan what techniques and measures are applied for software development.

(3) All software shall be based on open system concept, shall be modular and independent of type of processor or hardware platform.

(4) The Software shall be developed on 64 bit UNIX/Windows/ or Multitasking Platform. All software shall be portable across similar operating systems.

(5) The TMS database shall be based on Relational Database Management System.

(6) It shall be possible to query the database either through format driven commands or by simple parameter related commands. These shall be formalised in consultation with the Engineer.

(7) The Contractor shall provide the procedures for maintenance of the security of the TMS system software along with application data considering sabotage, unauthorized Access, Virus etc. Suitable protection against Virus shall be provided.

2.3.10 Interface Requirements

(1) **Interface between TMS and SCADA system**

Interfacing with the OHE SCADA system shall be provided to achieve following information exchanges between TMS & SCADA:

(a) The RPS display screens, including display controllers, for SCADA system shall be provided by the Contractor. TMS shall interface with SCADA system to exchange any data between two systems. The contractor shall exchange and agree on the protocols and hardware/software interfaces between the systems. In case of conflict, the Engineer’s decision shall be final.

(b) TMS will take OHE shut down reports from SCADA system.

(c) TMS will take details of the various power blocks granted and their duration from SCADA system.

(d) TMS will take details of OHE failures and tripping details of FP, SP, and SSP.

(e) SCADA will pick up failure of AT supply details from TMS.

(f) Any other information considered necessary by the Engineer.

(2) **Interface with Master Clock System**

(a) The system clock shall be synchronized with Master clock provided in OCC under PS (Telecommunications).The Contractor shall propose a suitable synchronization system in the event of failure of the Master Clock.

(3) **Interface with FOIS**

(a) The integration of TMS with FOIS network of IR shall ensure seamless data flow between the systems, so as to operate train services across DFCCIL and IR without or with minimal manual intervention during exchange, change in route, train composition, destination, origination, Expected Arrival Time (ETA)/Expected Departure Time (ETD) etc.

(4) **Interface with other TMS**

(a) The TMS provided under this contract shall be designed to interface with TMS provided for other sections of EDFC.

(b) It is a requirement that the train ID generated in one TMS system continues to be maintained or updated automatically with relevant information when the train moves into the adjacent section, provided with TMS of another vendor.

(c) Similarly, it is a requirement that the Signalling indications of one TMS section are exchanged with TMS of other sections when train crosses the boundary of the two sections.

(d) The contractor shall prepare Interface specification jointly with the contractors of other sections of EDFC detailing the information required to be shared between TMS provided by him and the TMS of other sections of EDFC. The contractor shall share all the required information of his TMS, including the data formats, protocols, physical/logical connectivity and limitations related to the interface, with the Employer/other contractors, to enable them design their interface. Similarly, the contractor shall obtain all the required information from TMS providers of other sections of EDFC and design its interface accordingly.

(e) The Central Server provided under this contract shall interface with Central server (s) of EDFC phase-1 contract for seamless exchange of information, including but not limited to the following:

(i) Train schedule information: Daily/seasonal Time table etc.
(ii) Train running information: Train identification, type, composition, crew details, dynamic location etc.
(iii) Train approaching the boundary of adjacent section.
(iv) Special events: Unusual delays, Loco fault, any unusual alarms etc.
(v) Any other information as required during the execution of the contract.

(f) The TMS of this contract shall normally use the Timetable and Crew Management system provided in EDFC Phase 1. To aid implementation, the contractor shall supply the necessary sectional data of EDFC Phase 2 to the contractor of EDFC Phase 1. Not only that the TMS provided under the contract be designed to receive the Timetable and Crew Management information from the Central server of TMS of EDFC Phase 1 but also it shall have facility to carry out any updates in the Timetable and Crew Management information provided in Central Server of EDFC Phase 1.

(g) The format of data exchange should be non-proprietary and vendor independent/open type such as XML, CSV, text strings etc. The protocol used for interface shall be industry standard open protocol, which shall be easily configurable such as Modbus TCP, Webserver etc. It shall be possible to establish/configure logical link between server/systems of adjacent TMS. The communication protocol used for TMS-TMS interface shall be TCP/IP based and data routing shall be possible by IP configuration.

(h) The interconnection with the neighbouring TMS shall be based on UIC or other equivalent standards.

(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 Employer's requirements, for a speed potential of 100 Kmph on the main line, 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, including available 'Headway.'

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 and this PS.

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/DFC 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:

(a) A fault in an equipment or sub-system while operating within its design and environmental specification limits;

(b) Improper operation, maintenance, or testing of the item as a result of the Contractor supplied documentation.

(c) 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.

3.4.3 Non-relevant Failure: Any failure of an item not included in the definition of relevant failure, such as the following:

(a) A failure caused by malfunction of other equipment or sub-system that are not supplied by the Contractor.

(b) A failure caused by human error, except as noted in Relevant Failure above;

(c) A failure caused by accidents not associated with the normal operation of the item.

(d) A failure caused by operating the equipment or sub-system outside of design or environmental specification limits.

3.4.4 Service Failure: Any relevant failure or combination of relevant failures during revenue service operations to determine availability for revenue service, which results in one of the following:

(1) Delay to train service;

(2) Fault preventing a train from entering service at its scheduled time.

3.4.5 Pattern Failure: The repeated occurrences of 3 or more relevant failures of the same replaceable part, item or equipment in same manner in identical or equivalent applications when they occur at a rate which is inconsistent with the predicted failure rate of the part, item or equipment will be termed as pattern failure.

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 Para 2.2.5 (2) (l) 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 and other Signalling sub-systems 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 3.4.3 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

System/Sub-System	Availability	Remarks
Track Vacancy Detection System (MSDAC/SSDAC, power supply, etc.)	99.99%	Availability per system
Train Management System	99.98%	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 **Service Life support** :

(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 Contract Package CP-104 are being upgraded/augmented/ reconfigured under this Contract, this support during service life for operation, maintenance, customization and upgradation shall be available for these equipment.

(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.

(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.

(4) The Contractor must ensure the following, but not limited to :

(i) 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.
(ii) Availability/Establishment of Organization in India that can enter into Annual Maintenance Contract (AMC) with the Employer.
(iii) 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 yard modification/signalling equipment up gradation etc.
(iv) Supply of Spares for entire Service life of the equipment.
(v) Supply additional equipment required for replacement or expansion of the network in future.
(vi) Training of Employer's Personnel in Operation and maintenance of existing and new/modified equipment/sub-systems.

(5) The sub systems/systems of OEMs who are for complete Transfer of Technology (TOT) including system assembly, manufacturing, installation, maintenance and software modification/customization, training etc. shall be preferred for use by the Employer. In such case, the Contractor shall submit the detailed plan for progressive manufacture of imported items by OEM in India.

3.9 Line Replacement Unit (LRU)

3.9.1 All line replaceable units shall have weight that can be easily handled manually without posing any significant risk. The System shall allow the removal and reinstallation of LRUs without having to remove other LRUs, disconnect cables to other LRUs or disturb or power down other equipment.

3.9.2 Incorrect installation or incorrect attachment of any LRU to be prevented through mechanical design.

3.9.3 The System shall be designed to ensure that any components which are physically interchangeable but not functionally interchangeable cannot operate in the System.

3.9.4 LRU electrical connections shall be formed by using plugin units as far as practicable.

3.9.5 The System shall be designed such that Electronic racks are removable. The System shall be designed such that access panels can be removed without the use of special tools.

3.9.6 The System shall maximize the use of remote means to conduct maintenance, fault finding and fault rectification activities and to access maintenance information.

3.9.7 The Signalling System shall display all detected failures on the S&D terminal at the Station and in the OCC.

3.9.8 Fault indications should clearly indicate which LRU is affected and the degree of the failure and loss of functionality.

3.9.9 Where the System architecture is such that Signalling control systems are distributed across the section and where all maintenance testing and diagnostics cannot be conducted entirely remotely from the OCC, the local Control and Indication means shall be provided at these locations for maintenance purposes.

3.10 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.

3.11 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.

3.11.1 Safety Principle

(1) All equipment and sub-systems, including software, affecting safety and identified as being "vital", shall be designed according to the following principles:

(a) Only components having a high reliability and predictable failure mode shall be used.

(b) Components must be utilized in such a manner that ensures that a restrictive, rather than a permissive condition will result from hardware, software or any part of the equipment failure.

(c) 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.

(d) System safety equipment design shall be such that any single independent component or subsystem failure results in a restrictive condition. 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.

(2) The Signalling system shall fully conform to the interlocking principles as specified in the Indian Railway Signal Engineering Manual.

(3) 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.

3.11.2 Safety Requirements

(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.

(2) The safety level of Electronic Interlocking (EI) and Track Vacancy Detection Systems realized with software shall satisfy the SIL4 or equivalent safety level. The software design process of TMS shall conform to SIL 2 level.

(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.

(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:

(a) Variation in power supply beyond its tolerance limits.

(b) Spikes in the power supply system.

(c) Insertion of PCBs in wrong card slots.

(d) Earthing of any component or wire or a combination of such earthing faults.

(e) Broken wires, damaged or dirty contacts, failure of a component to energize, loss of power supply or blown fuses etc.

(5) During each stage in the design and development process, the Contractor shall take cognizance of any hazard that arise as a result of the design or operation of the proposed equipment and take immediate steps to change the design or operation principals of the proposed equipment to mitigate the hazard.

(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.

(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.

(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.

(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.

(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.

(11) All metallic enclosures shall be provided with an earth terminal.

(12) The design of the System shall minimize the risk of fire.

(13) The design of the System shall minimize the build-up of static, as well as the effects of static discharge during maintenance.

(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.

(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.

3.11.3 Risk Acceptance Criteria

(1) Risk is defined as probable rate of occurrence of a hazard causing harm and the degree of severity of the harm. Risk acceptance shall be based on the principle of "As Low as Reasonably Practicable" (ALARP) based on the guidelines set out in EN 50126.

(2) The frequency of occurrence of hazardous event is categorized into different rankings:

Category	**Description**
Frequent	Likely to occur frequently. The hazard will be continually experienced.
Probable	Will occur several times. The hazard can be expected to occur often.
Occasional	Likely to occur several times. The hazard can be expected to occur several times.
Remote	Like to occur sometime in the system life cycle. The hazard can be reasonably expected to occur.
Improbable	Unlikely to occur but possible. It can be assumed that the hazard may exceptionally occur.
Incredible	Extremely unlikely to occur. It can be assumed that the hazard may not occur.

(3) The hazard severity is categorized into different hazard consequence levels:

Hazard Category	Consequence	Description
4	Catastrophic	Operating conditions such that personnel error, environment, design deficiencies, subsystem or component failure or procedural deficiencies may cause death or system loss.

Hazard Category	Consequence	Description
3	Critical	Operating conditions such that personnel error, environment, design deficiencies, subsystem or component failure or procedural deficiencies may cause severe injury to personnel, severe occupational illness or major system damage.
2	Marginal	Operating conditions such that personnel error, environment, design deficiencies, subsystem or component failure or procedural deficiencies may cause minor injury to personnel, minor occupational illness or minor system damage. Acceptable with adequate control and agreement of the Employer.
1	Negligible	Operating conditions such that personnel error, environment, design deficiencies, subsystem or component failure or procedural deficiencies will not result in injury to personnel, occupational illness or damage to the system.

(4) Risk classification of hazards:

Frequency		Consequence			
		Catastrophic (Category 4)	Critical (Category3)	Marginal (Category2)	Negligible (Category1)
Frequency	Frequent	I	I	I	II
	Probable	I	I	II	III
	Occasional	I	II	III	III
	Remote	II	III	III	IV
	Improbable	III	III	IV	IV
	Incredible	IV	IV	IV	IV

(5) The Risk Classes are defined as follows:

Risk Class		Interpretation
Class I	Intolerable	Intolerable risk. Shall be eliminated
Class II	Undesirable	Undesirable risk, and tolerable only if risk reduction is impracticable of if the costs are grossly disproportionate to the improvement gained. Shall only be accepted when risk reduction is impracticable and with the agreement of the Railway Authority or the Safety Regulatory Authority, as appropriate
Class III	Tolerable	Tolerable risk if the cost of risk reduction would exceed the improvement gained. Acceptable with adequate control and with the agreement of the Railway Authority.

Risk Class		Interpretation
Class IV	Negligible	Negligible Risk. Acceptable with/without the agreement of the Railway Authority

(6) Risk acceptance shall be based on the principles of "As Low as Reasonably Practicable" (ALARP) and as follows:

(a) Category 4 hazards shall be not greater than one unsafe incident in one hundred years (1:100 years).

(b) 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.

(c) Category 2 hazards shall only be permitted if a desired benefit is demonstrated as generally acceptable within accepted levels for the international railway industry and in agreement with the Employer.

(d) Category 1 hazards shall only be permitted if assured that the risk will remain at that level and any residual risk shall be mitigated by Operating Rules and Procedures

3.11.4 Hazard Analysis

(1) The Contractor shall, as part of the safety analysis, prepare analysis to identify Hazards and ensure their satisfactory resolution. The following analysis shall be prepared and submitted by the Contractor for the 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)

(2) The Contractor shall carryout the Hazard Analysis and FMECA/FTA for key equipment / sub-systems / systems. As a result of hazard analysis, the Contractor shall:

(a) Identify and list the hazards

(b) Identify and list the Safety Requirement Specifications

(c) Identify and list the safety related functions

(d) Specify for each safety related function the safety related failures

(e) Identify and list the safety critical and non-safety critical items.

(3) The Hazard 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.

(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.

(5) The Hazard Log shall be substantially complete 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.

(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.

(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 behaviour.

(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.

3.11.5 Design/Systems Safety Studies and Report

(1) The Hazard analysis process shall identify the need for Design Safety Studies and the Hazard Log shall record the results of each of these Design Safety Studies.

(2) Design Safety Studies shall be undertaken for system and subsystem elements that are considered to be safety critical and that require hazard analysis to a greater level of detail than that applied at an overall system wide level.

(3) Design Safety Studies shall specifically refer to hazards arising from:

(a) normal operations including maintenance;

(b) degraded modes of operation;

(c) emergency situations; and

(d) the effectiveness of mitigation proposed for natural catastrophes.

(4) The Design Safety Studies shall take account of:

(a) methods of operation;

(b) RAM considerations;

(c) anticipated likely maintenance regimes and their sustainability in Commercial Operation;

(d) anticipated competence levels of personnel in Commercial Operation;

(e) software security (disabling of unauthorized access to operating systems, protection against intrusive attacks, loss of password integrity, etc.); and

(f) Other human factors including but not limited to those identified in ergonomic studies.

(5) Design/Systems Safety Studies and the Report shall demonstrate, as a minimum, the following requirements:-

(a) That the overall risk criteria for the Works have been addressed satisfactorily at the Detailed Design stage and that the Detailed Design proposals are mutually compatible with such risk criteria.

(b) That all Safety Critical systems have been identified at the Detailed Design stage and the apportionment of risk factors between the major systems and sub-systems support the overall safety criteria approved in the “System Safety Plan”.

(c) That the results of the Design Safety Studies have been incorporated into the design, and shall be carried forward into the Final Design, manufacturing and installation processes.

(d) That where management by operating and/or maintenance procedure or other management control measures have been identified during the “Design Safety Studies”, auditable methods by which such measures shall be introduced into operating/maintenance provisions have been established.

(e) That robust processes have been implemented to validate the Safety Critical aspects of software design.

(f) That processes for assessing the potential safety impact of design changes exist.

(6) The Design/Systems Safety Studies and a Report shall be submitted at the completion of the Detailed Design period to confirm that all safety related aspects of design have been properly addressed and comprehensively validated.

3.11.6 Engineering Safety Validation Plan and Report

(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 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.

(2) An Engineering Safety Validation Report will be submitted after the completion of this testing.

3.11.7 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.

3.11.8 Relational Database Management System

(1) All hazard resolution by procedural control shall be cross-referenced from the

safety critical and non-safety critical Items List to the appropriate manuals. The results of the Hazard Analysis shall be recorded and maintained by the Contractor in a Hazard Log in the form of a relational database that can be used to track progress in the implementation of mitigating actions and control measures, and provide an easily accessible reference for the future Operator of all actions taken with respect to any hazard of any type in an any location for any area of activity. Proper cross-referencing to the hazards and resolution measures shall be provided in all these afore mentioned documents.

(2) The fully functional soft copy of the relational database management system shall include together with all passwords, supporting software and instructions on its use and further development during Revenue Service.

3.12 RAM Demonstration

3.12.1 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.

3.12.2 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 a process for reporting, classifying, analysing failures, and planning corrective actions in response to those failures.

(b) Collect data, record and analyse system failures.

(c) Produce a history of failure and corrective actions.

3.12.3 Reliability Demonstration

(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.

(2) In case the Contractor is not able to achieve specified/predicted reliability target, the Contractor shall take necessary corrective measures either by way of change of design and/or replacement of the relevant equipment / component, at no additional cost to the Employer.

(3) The Contractor shall 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.

3.12.4 Maintainability Demonstration

(1) The Contractor shall carry out tests on all the system provided by him to demonstrate that all maintainability predictions provided are met.

(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) A minimum of 50 maintenance actions shall be included for this demonstration.

(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.

(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.

(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.

3.12.5 **Availability Demonstration**

(1) The Contractor shall demonstrate the specified Availability during Service Trials and during the DLP. The Availability Demonstration Testing (ADT) shall be conducted on all Systems, subsystems and their interfaces.

(2) 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) The availability shall be worked out on the basis of the formula given during the preceding six months. In the event that the availability target as specified is not achieved, the Contractor shall,

(a) The determination of availability achievement in the preceding six month period shall be continued at monthly intervals until the target is achieved.

(b) The contractor at his own expense, will take action deemed necessary to meet the availability requirement.

3.13 Environment

3.13.1 Details of climatic conditions generally prevalent in Deen Dayal Upadhyay-New Bhaupur section are given in Para 18.0 of GS Vol.2 Part 2 Section V(A).

3.13.2 The Signalling Equipment rooms in OCC and at the stations will be built and provided with air-conditioning by 'Other contractors' and will have following Environment classifications:

(1) Signalling Equipment Room(s) in OCC: Class A

(2) Signalling Equipment Room(s) at Station: Class B1

3.13.3 The Signalling Equipment Rooms and Signalling Power Supply Equipment Rooms in the Block section to be built by the contractor, and Signalling Power supply Equipment rooms at the Stations, being built by 'Other contractors' shall normally have following Environment classifications:

(1) Signalling Equipment Rooms in Block section: Class B2

(2) Power Supply Equipment Rooms at Stations and in Block sections: Class B2

The contractor shall provide in the above rooms, suitable ventilation system with redundancy (1+1) to regulate temperature and maintain air circulation within limits. The contractor may, however provide Air-conditioning of these rooms/equipment racks, wherever necessary for environment control or for improvement of reliability of specific Signalling equipment or its power supply.

3.14 EMC/EMI Requirements

3.14.1 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 Para 4.1.2 of this specification.

3.14.2 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.

3.14.3 EMC Control Plan

(1) The contractor shall prepare an EMC control plan and submit it to Engineer for review and acceptance.

(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) The Plan shall specify measures to increase immunity of the Signalling system.

(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.

(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.

3.14.4 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 Para 4.1.2 of this specification

3.14.5 Inter system EMI

(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.

(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.

3.14.6 EMC Tests

(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 reports are 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

(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) For any standard off-the-shelf products, their EMC test certificates shall be submitted to the Engineer for review.

3.14.7 Safety related Systems Interference (Hardware/Software interfaces & protocols)

(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.

(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/check sum 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.

3.14.8 Installation mitigation guidelines for Cabling

(1) The cables used in the Signalling system shall be adequately protected against external interference.

(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) The cables shall also be installed at a safe separation from potential interfering sources, including power cables etc.

(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.

(5) The Contractor should refer to guidelines recommended by IEC61000-5-2, wherever possible for signal trunking /conduit separation.

(6) For protection against electrostatic capacitance coupling, direct electrical connection between ducts of power cables and signal cables shall be avoided.

3.14.9 The latest versions of IEC61000-5 and other relevant standards shall be complied with wherever applicable.

(End of Chapter 3)

CHAPTER 4: GENERAL REQUIREMENTS

4.1 Project Design Standards

4.1.1 High Level Standards

(1) The project requires contractors to work within the framework of the international standard for Quality Management ISO 9000.

(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.

(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

(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

(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.

(3) For the Signalling system, the following specified standards (with latest amendments) shall be followed:

SPECIFICATION NO.	DESCRIPTION
IRS SPECIFICATIONS	
S 6-81	Tubular Steel Signal Poles
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

SPECIFICATION NO.	DESCRIPTION
S 34 – 68	Testing Railway Signalling relays (General)
S 36 – 87	Route Relay interlocking systems
S 42 – 85	Axle counting equipment
S 43 – 73	Automatic signalling for unidirectional traffic
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 101 – 90	Railway Signalling symbols
S 105/2012	Block Proving by Axle Counter using UFSBI
TC-30/2005	Four / Six Quad Underground Jelly Filled Cables
TC-55-2006	24 Fibre Optic Fibre armoured cable
RDSO SPECIFICATIONS	
RDSO/SPN/144/2006	Safety & Reliability requirement of Electronic Signalling Equipment
RDSO/SPN/153/2011	LED Signal lighting unit
RDSO/SPN/165/2012	Integrated Power supply system (IPS)
RDSO/SPN/175/2005	Solid State Block Proving by Axle Counter (Digital)
RDSO/SPN/176/2005	Multi Section Digital Axle Counter
RDSO/SPN/177/2003	Single Section Digital Axle Counter
RDSO/SPN/188/2004	Block proving with Axle counter
RDSO/SPN/189/2004	Terminal Blocks,Fuse terminal blocks and Miniature fuse links of international standard for Railway Signalling
RDSO/SPN/192/2005	Electronic interlocking
RDSO/SPN/197/2008	Code Practice for Earthing and Bonding system for Signalling equipment
RDSO/SPN/203/2011	Electronic Interlocking for Big Yards

SPECIFICATION NO.	DESCRIPTION
RDSO/SPN/204/2011	Double Walled Corrugated HDPE ducts for signalling cables
RDSO/SPN/208/2012	Electric Lifting Barrier
STS/E/Relays/AC Lit LED Signal/09	Universal Plug-in type, tractive armature AC Lamp proving relay (metal to carbon) for 110V AC LED Signal Lamp
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, Maintainability and Safety (RAMS)
EN 50128	Railway applications - Communication, signalling and processing systems - Software for railway control and protection systems
EN 50129	Railway applications - Communication, signalling and processing systems - Safety related electronic systems for Signalling
EN 50159 – 1	Railway applications - Communication, signalling and processing systems - Part 1: Safety related Communication in closed transmission systems
EN 50159 – 2	Railway applications - Communication, signalling and processing systems - Part 1: Safety related Communication in open transmission systems.
EN 60529	Specification for degrees of protection provided by enclosures (IP Code)
EN 50081 – 2	Electromagnetic compatibility - Generic Emission Standards - Part 2: Industrial Environment
EN 50123	Railway Application-Fixed installations .D.C. Switchgear. General
EN 50082 – 2	Electromagnetic compatibility. Generic immunity standard. Industrial environment.
EN 60364	Lightning and Surge protection
EN 61643	Lightning and Surge protection

SPECIFICATION NO.	DESCRIPTION
EN62305	Lightning and Surge protection
EN 60204 – 1	Safety of machinery. Electrical equipment of machines. General requirements
IEC 61000.4.2	Electromagnetic compatibility (EMC) - Testing and measurement techniques - Electrostatic discharge immunity test and basic EMC
IEC 61000.4.4	Electromagnetic compatibility (EMC) - Testing and measurement techniques - Electrostatic fast transient/burst immunity test and basic EMC publication
IEC 61000.4.5	Electromagnetic compatibility (EMC) - Testing and measurement techniques - Surge and immunity test
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 62280-1	Railway Applications-Communications, Signalling and processing systems – Safety related communication in closed transmission 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 60364	Electrical Installations for Buildings
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

SPECIFICATION NO.	DESCRIPTION
ISO 11064 Parts 1-7	Ergonomics Design of Control Centres

4.1.3 Following manuals and schedules shall also be referenced during the design:

(1) Indian Railways Signal Engineering Manual (IRSEM).

(2) General Rules (GR) of DFCCIL/IR.

(3) AC Traction Manual (ACTM) of IR.

(4) Indian Railways Permanent Way Manual (IRPWM).

(5) Schedule of Dimensions (SOD) of Eastern Corridor of DFCCIL.

4.1.4 Following Indicative Typical arrangement drawings shall also be referenced during the design:

(1) Single line diagram for 1-phase input & 1-phase output UPS system (Annexure I of Appendix 2)

(2) Single line diagram for 3-phase input & 3-phase output UPS system (Annexure II of Appendix 2)

(3) DFCC Cable Laying in Station Yard (Annexure II (a) of Appendix 4)

(4) DFCC Cable Laying in Block section (Annexure II (b) of Appendix 4)

(5) Cable trench (Annexure III of Appendix 4)

(6) Laying of cables in rocky area (Annexure IV of Appendix 4)

(7) Track crossing(Annexure V of Appendix 4)

(8) Road crossing (Annexure VI of Appendix 4)

(9) Cable laying on culverts with low flood level (Annexure VII of Appendix 4)

(10) Cable laying on culverts with high flood level (Annexure VIII of Appendix 4)

(11) Cable laying on metallic bridges (Annexure IX of Appendix 4)

(12) Cable Trough for metallic bridges (Annexure X of Appendix 4)

(13) Typical Scheme of Track vacancy detection system using MSDAC in Automatic Block section.(Appendix 5)

(14) Typical Earthing and Bonding arrangement for Indoor Signalling equipment. (Annexure I of Appendix 6).

(15) Typical Earthing, Bonding and Surge Protection arrangement for Location box having Electronic equipment. (Annexure II of Appendix 6).

(16) Signalling System Architecture (Appendix 7)

4.2 General Requirements

4.2.1 Basic Design Philosophy and Requirements

(1) Proven Design

(a) The Contractor shall develop the design based on this particular Specification. The design details shall be submitted with technical data and calculations to the Engineer for approval.

(b) The Signalling and Train Control System including all sub-systems and

equipment shall be of proven design. The system/sub-system, equipment, hardware and software proposed by the Contractor shall have been in use and have established their satisfactory performance over a period of at least two years on the world wide railway/metro systems during last five years from the base date.

(c) Where similar equipment or sub-systems of a different rating are already proven in service, then the design shall be based on such equipment. In case these stipulations are not fulfilled, the Contractor shall furnish sufficient information to prove the basic soundness and reliability of the offered Sub-system.

(2) The design philosophy should meet the following criteria:
(a) Application of state-of-the-art Technology
(b) Service proven design.
(c) Minimum life cycle cost
(d) Ease of maintainability
(e) Use of interchangeable, modular components
(f) Extensive and prominent labeling of parts, cables and wires
(g) Use of unique serial numbers for traceability of components
(h) High reliability
(i) Energy efficiency
(j) System safety
(k) Adequate redundancy and factor of safety
(l) Environment friendly
(m) Adherence to technical specifications.
(n) Open Architecture for integration with other Systems
(o) Ease of expansion and integration.
(p) Protection against theft/pilferage.

(3) Adequate margin shall be built into the design particularly to take care of the environmental considerations prevailing at the location of the project.

(4) All Signalling system designs of hardware and software shall be prepared by experienced Signalling Engineers. All Signalling system installation, testing and commissioning shall be executed by well trained and qualified engineers under the leadership of an experienced Signalling testing manager.

4.2.2 Design Principle

(1) Signalling system shall be designed as per the requirement of Indian Railway General Rules and Indian Railway Signal Engineering Manual.

(2) Firstly, system contractor shall plan, design, drawing and execute all the S&T work including LC gate common items (cabling, analog and digital requirement etc.) of entire section considering standard automatic signal block working with keeping the additional provision of LC Gate Signals & track detection system etc. (if any) in design and drawing except exclusive physical work of interfacing, indoor & dependent outdoor work of each LC gate. However, LC gate locations (Chainage etc.) may be used as reference for design and drawing purposes at this stage.

(3) All interfacing S&T cables with IR & DFCCIL and other items pertaining to each LC gate shall be identified and secured at adequate distance from it to avoid damage during construction of ROB/RUB and readily available for extension at LC gate/LC gate goomty/IR at later stage for execution of LC gate interlocking when interfacing issues sorted out. It shall be done as per approval of Engineer.

(4) In due course of time and subsequent finalization of interfacing issues (ESPs & other issues etc.) with IR of each LC gate, all work at LC gate viz. design & drawing for LC, Construction of LC gate goomtys, IPS & Battery, ELB, sliding booms, LC interlocking,

approach locking, warning, auto changeover at LC gate Lodge, ATs, Road signals, physical interfacing work with IR & DFCCIL, Domino Panel and modification in the approved plan, design and drawing etc. as stated above Para-3.2.2 shall be done.

(5) S&T structures and cabling of signal & telecomm cables near LC gates shall be planned & executed in such a way that during elimination of LC gates by ROB/RUB etc., interruption in S&T working shall be minimum. Before execution, required design & drawing plan are to be approved by Engineer.

4.3 Procurement

4.3.1 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 Specification for reference.

4.3.2 Equipment appearing in this list of applicable RDSO specifications at Para 4.1.2 and having RDSO approved vendor, shall be procured from RDSO's "Approved list of firms for manufacture and supply" and as per relevant specification.

4.3.3 Designated equipment shall be procured from RDSO's "Approved list of firms for manufacture and supply" and as per relevant IRS/RDSO specifications. Point machine with corresponding ground connections to suit canted points (1 in 20 cant turn outs) with thick web switches shall be got approved from RDSO/Employer/Employer's Representative/Engineer.

4.3.4 If any equipment other than covered above is proposed to be supplied, then the same must be proven being in regular use and having established its satisfactory performance over a period of at least two years during last 5 years on the World wide Railway/Metro system. Details of the same should be submitted well in advance for review and approval by the Engineer.

(End of Chapter 4)

CHAPTER 5: CONSTRUCTION REQUIREMENTS

5.1 General

5.1.1 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 and installation in the system and associated activities.

5.1.2 The requirement of Construction/Installation Plan, Method Statement, Manufacturing/Procurement, Delivery, Storage and Installation at site are covered in detail in GS Part 2 section V(A). The requirement given here are specific requirements to be read in conjunction with the general requirements given in the GS.

5.1.3 The Contractor shall be required to demonstrate that the construction/installation system/procedure he has 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.

5.2 Installation

All the important Signalling equipment viz. EI, MSDAC, LED signals, IPS/UPS, Data loggers, point machines etc. shall be installed in accordance with RDSO/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. The equipment shall not be commissioned unless such a certificate has been issued by the OEM.

5.2.1 Indoor Installation

(1) All items of Signalling system comprising active electrical and electronic components shall,as far as possible be located in the Signalling equipment rooms.

(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.

(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.

(4) The equipment layout within the equipment room shall be designed to:

(a) Allow sufficient clearance for escape out of the equipment rooms in case of emergency.

(b) Allow sufficient space at the front and at the back of the equipment for the maintainer to attend to the equipment freely without obstruction.

(c) Allow required space around the equipment as mandated by the

OEM/RDSO specification.

(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:

(a) Drawings showing the equipment layouts and positions of the racks, cabinets and enclosures.

(b) Racks, cabinets, layout drawings showing the arrangement of individual module.

(c) Specifications, sample of all the mounting brackets and accessories.

(d) Equipment mounting and installation methods.

(e) Schematic diagrams and wiring diagrams of the System.

(f) Electrical distribution schematics within the room including the earthing details and

(g) Cable route diagrams for cables within the room.

(6) Installation work inside the room shall be carried only after these submissions have been reviewed without objection by the Engineer.

5.2.2 Signalling Structures

(1) For housing the Signalling Indoor equipment, at least the following structures shall be provided at each location.

(a) One Signalling equipment room (SER) for housing Signalling equipment.

(b) One Signalling Power Supply Equipment room for housing Signalling Power supply equipment including batteries.

(2) The size/layout of SER will depend on the number of indoor equipment units, their size and installation as per contractor's design and equipment layout approved by the Engineer. The size of the SER shall be determined keeping provision of a 19" rack for future provision for TPWS and further space for a 19" rack for any future expansion/modification requirement.

(3) The Signalling Equipment rooms and Signalling Power supply equipment rooms for housing the Central Interlocking Unit at Stations are being built under CP 201 & 202 as part of Station building. The Contractor shall coordinate with contractor of CP 201 & 202 for construction of the same. The Station Building Plans are given in Part 4 - Reference documents. The air-conditioning of SER at Stations is being provided under CP 204 and for which too, the contractor should do the required coordination. The additional building if any, required for housing object controller/EI of distributed interlocking at the Station shall be built by the Contractor.

(4) The building of Signalling Equipment rooms and Signalling Power supply equipment rooms in the block section is within the scope of present contract and their number and location will be determined by Signalling design. These Signalling structures shall be located, to the extent possible near the Railway Level Crossings and adjacent to the Telecommunication structures. The Signalling power supply equipment rooms can be combined with the Telecommunication power supply rooms where they are co-located. The contractor shall provide the ventilation and air-conditioning of these rooms in accordance with relevant provisions of this specification.

(5) Opening/closure of Signalling Equipment rooms at the station and in the block sections shall be indicated on the SM's Control Terminal and Signalling

maintainer's S&D workstation at the Station, and at the OCC.

(6) Arrangement for remote monitoring of the air-conditioning system, temperature-regulator equipment and air-circulation equipment of Signalling Equipment Rooms, Telecom Equipment Rooms and Signalling and Telecom Power supply Equipment rooms from OCC shall be provided, as part of S&D system

(7) Portable Fire Extinguishers shall be provided in all the Signalling equipment rooms and Power supply equipment rooms at the Station and Auto Location Huts. Portable fire extinguishers shall be compliant to NFPA 10 standard and suited for electrical equipment fires.

(8) Smoke and Fire detection system will be provided in all Signalling Equipment rooms and Signalling Power supply equipment rooms with facility of alarm generation at station and OCC, under Contract Package 204. The Contractor shall do the necessary coordination for implementation of the same.

(9) Some of the buildings (SER/TER) will be made available to the contractor. The detailed status of these buildings (build/partially build/completed) has been provided under Appendix-15, Part-2, Section V(A). Any alteration/addition shall be done by the S&T Contractor**.**

5.2.3 Outdoor Installation

(1) All the ducts/ troughs/pipes for laying cables will be provided by the contractor, except the following, which will be provided under Contract Package CP 201 & 202:

(i) At LC gates

- 2X200mm dia. RCC pipes across the formation near the gate lodge.
- 1X200mm dia. RCC pipe across the road surface on both sides near the lifting barriers.

(ii) At Crossing Stations

- 2X200mm dia. RCC pipes across the formation near the centre line of the station yard.
- 1 X 200mm dia. RCC pipe at both ends of the station yard near the facing points for the loop lines

(iii) At Junction Stations/Yards

- 3X200mm dia. RCC pipes across the formation near the centre line of the station yard.
- 2X 200mm dia. RCC pipe at both ends of the station yard near the facing points for the loop lines
- 1X 200mm dia. RCC pipe at both ends of the station yard near the outermost crossovers.

(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.

(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.

(4) All trackside equipment and the mounting method shall be designed in a way to

minimize frequency of preventive maintenance and theft and vandalism.

(5) The Contractor shall submit the following to the Engineer for review at least three months before the commencement of the outdoor installation activities:

(a) Specifications, sample of all the mounting brackets and accessories.

(b) Equipment mounting and installation methods and

(c) Schematic diagrams and wiring diagrams of the System.

(6) All warning boards, Markers, Signal name plates, concern Signal, instruction boards etc. shall be provided with retro reflective or better type duly approved by Engineer.

5.2.4 **Equipment cabinets and Enclosures**

(1) The indoor equipment cabinets/ Enclosures housing Signalling Equipment shall confirm to IP 31 with glass doors.

(2) The Equipment Cabinets/Enclosures shall have sufficient EMI/EMC shielding as required by signalling equipment inside to remain EMI/EMC complaint. The cabinets/Enclosures housing processor based signalling equipment shall be EMI complaint as per IEC 61587-3

(3) The indoor Cabinets/Enclosures housing signalling equipment shall be provided with appropriate ventilation/Cooling arrangement based on Heat load calculation. The Contractor should get the ventilation/Cooling arrangement approved by Engineer before supplying the Cabinets/Enclosures for signalling equipment.

5.3 Signalling Cable Laying, Termination and Testing

5.3.1 Signalling Cables

(1) The Cables for carrying outdoor Signalling circuits shall be PVC insulated, PVC sheathed and armoured unscreened cable conforming to IRS specification IRS: S-63/2007. The cable conductor shall be of annealed copper having minimum cross sectional area of 1.5 sq. mm.

(2) The Cables for carrying Signalling power supplies outdoor shall be aluminium conductor, minimum conductor size 25 sq. mm, PVC – insulated armoured, unscreened, underground power cable as per specification IRS: S-63/2007 & IS: 1554 (Part-2). The size of conductor shall be so selected as to suit the electrical load.

(3) The Quad cable used for Axle Counter circuit shall be 4/6 quad Telecom underground Jelly filled cable as per IRS specification TC-30/2005.

(4) The Optic Fibre Cable for the Signalling system shall be provided under PS (Telecommunications) Vol. 8, Section V(B), Part-2. The Signalling system shall interface with the Telecommunication system for the same.

(5) Indoor cable/wire used shall be single/multi core, plain annealed high conductivity copper conductor, PVC insulated unarmoured as per IRS S-76/89. 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 contractor shall take prior approval of Engineer if indoor cable/wire other than RDSO approved are proposed to be used.

(6) 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.

(7) 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. Labels shall be provided at about 100 m spacing on complete length of all sizes of cables. Type of labels to be used shall be got approved from the Engineer.

(8) The DWC-HDPE pipe/duct used for protection of Signalling cables below the track or any other place shall be supplied to RDSO specification RDSO/SPN/204/2011.

5.3.2 Cable core allocation

(1) A cable core distribution plan shall be prepared for each installation.

(2) Preferably, 6/12/19/24/30 core signalling cables shall only be used to keep low the inventory requirement.

(3) Adequate spare conductors to a minimum of 20% of the total conductors used shall be provided for in each main cable. 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. Two nos. of 12 core dedicated spare cable may be provided in the station area from Home signal to Home signal and terminated in all locations for instant transfer of these dedicated conductors during cable failure and cable testing.

(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 if necessary function wise cables shall be provided. Auxiliary signals shall be taken in different cables. .

(5) A separate cable shall be used for operation and detection function of each point/crossover. No other function shall be taken in these cables.

(6) All the power cables shall be laid with redundancy i.e. 2 power cables for each circuit, with a changeover arrangement at either end.

(7) UP and DN track vacancy detection systems shall be in different cables. Cables for Main and Supervisory Track vacancy detection systems shall be separate.

(8) The Quad cable laid shall have one quad reserved for Emergency communication being provided under PS (Telecommunications) Vol. 8, Section V(B), Part-2. The quad cable used for signalling functions and emergency communication shall also have 20% (of the total conductors used) spare conductors.

(9) The Safety Critical Signalling systems such as EI, MSDAC etc. using OFC system for communication shall use dark fibres exclusively for Signalling use.

(10) Separate cable shall be used for location lighting. The Location lighting cable shall not carry any other signalling function.

5.3.3 Cable Route Plan

(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.

(2) While planning the cable route, any future yard modification etc. shall also be kept in view.

(3) As far as possible low lying areas, platform copings, drainages, hutments, rocky terrains, points and crossings, shall be avoided.

(4) The cable route plan shall show 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 lines and other items of importance.

(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.

5.3.4 Storing & transportation of cable

(1) Cable drums shall not be stacked on flat side. Suitable stoppers shall be placed for stability.

(2) Cable drums shall have easy access for lifting and moving.

(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.

(4) The drums shall not be rolled over objects that could cause damage to the protective battens of the cable.

(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.

(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.

(7) It is desirable that cable drums are stored in covered shed to protect against direct exposure to sun/rains.

5.3.5 Paying out the cable

(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.

(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.

(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.

(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.

(5) The wooden battens on the drums shall be carefully removed shortly prior to laying and before the drum is mounted on the jack.

(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.

(7) The in-charge of cable laying shall ensure proper synchronization of all labourers for smooth laying.

(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.

(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.

(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.

(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.

(12) Paying out of cable shall be done by rotating the cable drum and not by pulling the cable with excessive force.

(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.

5.3.6 Excavation and backfilling of the trenches

(1) 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 signal and beyond into block/automatic section.

(2) Digging of trench between IR track and DFC track shall be manual or mechanized as proposed by the contractor and approved by the Engineer for every Station & Block section separately.

(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.

(4) Trenches shall be straight as far as possible and steep angles shall be avoided.

(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.

(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.

(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.

(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.

(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 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.

(10) Backfilling of the trenches shall be done properly. The earth excavated shall be put back on the trench rammed and consolidated.

5.3.7 Cable Laying underground

(1) The cables may be laid underground, either in the trench, in ducts, in cement troughs, in pipes or in any other approved manner.

(2) 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 (Annexure-I of Appendix 4).

(3) 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.

(4) 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.

(5) Signalling cables shall not run with cables carrying high voltages or heavy currents and shall conform to the requirements specified in BS 7671.

(6) Signalling 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.

(7) All cables shall be laid along the track preferably one metre inside the EDFC boundary. If it is necessary to lay the cable outside the EDFC boundary, permission shall be obtained before starting the trenching.

(8) 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. When it concerns the laying of tail cables which serve the track apparatus etc., the depth shall not be less than 0.50 metres.

(9) 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.

(10) A typical arrangement of Cable Trench is shown in sketch no. SDO/CABLE LAYING/003 at Annexure-III of Appendix 4.

(11) A typical arrangement of position of trenches for cable laying in Station area and Block Section has been shown in sketch No. GGM/Signal/Indicative drawing No. 1 and GGM/Signal/Indicative drawing No. 2 placed at Annexure-II (a) of Appendix 4 and Annexure-II (b) of Appendix 4 respectively

(12) The cables used for providing redundancy/ring circuit in signalling circuits shall be laid in different trenches/ducts, separated by DFCCIL/IR track(s). In case, if site conditions necessitate that the trenches/ducts are to be made on the same side of DFCCIL track (not separated by DFCCIL/IR track(s)), then it should be done with the prior approval of the Engineer with two trenches made with separation of at least 4 metres, and trench/duct farther from the DFCCIL track having depth of

1.7metres. Wherever 4 meters separation is not available/ achievable, the cable laying shall be done as proposed by the Contractor and approved by the Engineer.

(13) At each end of the main cable an extra loop length of 6 to 8 metre shall be kept.

(14) 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.

5.3.8 Cable Laying in Electrified area

(1) The cable shall be laid at 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 metres, a minimum distance of 3 metres 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 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 in the event of the failure of an overhead insulator.

(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 one metre away from the 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 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.

(3) 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 metres away from the station earthing. The distance of 5 metres can be reduced to one metre provided the cables are laid in concrete pipes/heavy-duty HDPE pipes/ducts or any other approved means.

(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.

(5) 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 metres away from the centre of the Track.

5.3.9 Laying of different type of cable in same trench

(1) The OFC cable shall be laid in HDPE pipe as per Telecom manual. The cables other than OFC shall be laid directly in the trench (both Signalling & Telecom cables).

(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) Telecommunication cable

(ii) Signalling cable

(iii) Power cable

(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 by arrow of bricks between them.

5.3.10 Cable laying in ducts

(1) When cables are laid in rocky area, it is desirable to protect them with split RCC ducts of suitable design.

(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.

(3) The ducts shall be of such design as to prevent collecting the water in the duct.

(4) Cables in any conduits, trunkings or ducts shall not occupy cross-sectional space in excess of 50%.

(5) 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 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.

(6) 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.

(7) Where it is necessary to take the cables between the tracks, it shall be carried in trunking kept sufficiently below the ballast level.

5.3.11 Cable Laying in Solid & Rocky soil

(1) In case of rocky soil, the depth may be reduced suitably.

(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 0.05 metres 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.

(3) In case sharp edge of rocky ground cannot be protected with sifted earth, concrete/GI/CI/PVC/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.

(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.

(5) A sketch No. SDO/CABLE LAYING/008 showing laying of cables in rocky area is placed at Annexure-IV of Appendix 4.

5.3.12 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/GI/CI/PVC/DWC-HDPE pipes properly jointed to prevent ingress of moisture.

5.3.13 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 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.

5.3.14 Track crossing

(1) As far as possible, the cable shall be crossed from one side of the yard to the other, at minimum number of locations.

(2) Track crossing shall be through trenchless method. The following precaution shall be taken:

(a) The cable crosses the track at right angles.

(b) The cable does not cross the track under points and crossings.

(c) The cable is laid in concrete/GI/CI/PVC/DWC-HDPE pipes or suitable ducts or in any other approved manner while crossing the track.

~~(d)~~ Cable laid across the track must be 1.0 metre (minimum) below the ground level.

(e) No digging shall be done below the sleepers.

(f) A sketch No. SDO/CABLE LAYING/009 showing track crossing is placed at Annexure-V of Appendix 4.

5.3.15 Road crossing

(1) Road crossing shall be done through trenchless method. The cable shall be laid in concrete/GI/CI/PVC/DWC-HDPE 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.

(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.

(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.

(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.

(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:-

(a) 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

(b) 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.

(6) A separate pipe of suitable diameter shall be used for telecommunication cable.

(7) A sketch No. SDO/CABLE LAYING/010 showing road crossing is placed at Annexure-VI of Appendix 4.

5.3.16 Cable laying on bridges/culverts

(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. SDO/CABLE LAYING/011 showing cable laying on culverts with low flood level is placed at Annexure-VII of Appendix 4. Wherever cable may not be taken underground across the drain bed, cable shall be taken on the culvert through GI/DWC-HDPE pipe of suitable sizes. A sketch No. SDO/CABLE LAYING/012 showing cable laying on culverts with high flood level is placed at Annexure-VIII of Appendix 4.The CST contractor (CP 201 & 202) is to provide ducts on the concrete bridges and culverts. The same may be used by the contractor for laying of S&T cables.

(2) When cables have to cross a metallic bridge, they shall be placed inside a metallic through 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 2 to 3 meters shall be made available at the approaches of bridge. A sketches No. SDO/CABLE LAYING/013 & 014 showing cable laying on metallic bridges are placed at Annexure-IX& Annexure-X of Appendix 4.

(3) In case of arch bridges, cable shall be taken through GI/DWC-HDPE pipes on top of the arch adjoining the parapet wall. The pipe shall be covered with ballast.

(4) 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).

(5) 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.

(6) 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.

(7) 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.

5.3.17 Cable Laying in monsoon season

(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.

(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.

5.3.18 Laying of cable above ground

(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:

(a) 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.

(b) The cable supports shall be so spaced as to avoid sag.

(2) Indoor Signalling cable shall normally be laid on ladders, channels or in any other approved manner. The cables shall be neatly tied/ laced.

(3) 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.

(4) All cables in OCC being provided in false floor shall be neatly secured on cable channels

5.3.19 Cable markers

Underground Cable Route shall be identified by Electronic Cable Markers directly buried inside the trench at 30-40 m interval and at diversion points with the approval of Engineer. Electronic cable marker should be robust, passive, non-rusting & water proof. It shall be possible to trace their location with the help of cable marker tracing unit up to a depth of 1.5meters.

5.3.20 Entry of cable at cabin, relay room, location boxes etc.

(1) All cable entry points in the Equipment room, battery room, SM's room shall be sealed using modular based cable and pipe sealing system based on multi-diameter technology as per RDSO specification No. RDSO/2008/EL/Spec/0067. All cable entries from/to adjacent rooms through overhead duct/ladder shall also be sealed. The sealing system must have 20% built in capacity for future need of adding more cables.

(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 equipment rooms at the Station and auto location huts.

(3) Cable shall be protected on both sides up to a distance of 10 metre beyond building line of Signalling equipment rooms and battery room SM's room. In case of location/junction boxes, etc. cable may be protected for 1 metre on each side.

(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.

(5) Cable should be entered in location box and their coils buried at a minimum depth of 0.5 meter.

5.3.21 Termination of cables

(1) No jointing of cables is permitted. All cables shall be terminated.

(2) The cable termination of Signalling cables shall be undertaken on approved type terminations on CT racks/ location boxes/junction boxes.

(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.

(4) Unused cable cores/pairs of multi-core/pair cables shall also be terminated and marked so.

(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.

(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.

(7) The cable terminations shall be secured enough to withstand vibration level that is likely to be experienced in the DFCCIL environment.

5.3.22 Cable Termination Rack (CTR) and Location Box

(1) Cable Termination Rack (CTR) with 20% extra capacity for future expansion shall be provided.

(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 No RDSO/SPN/189/2004. If any alternative terminal type is proposed for use, it should be got approved by Engineer.

(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 Para 5.4.5(4)(c) of this specification.

(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.

(5) The Outdoor cables shall be terminated in Location Boxes.

(6) Location boxes shall be rugged and free from ingress of rodents, insects, dust, moisture and water.

(7) Location boxes shall be able to withstand vibration level, likely to be experienced alongside the track.

(8) Location boxes shall be theft and vandal proof as far as possible and shall be able to withstand the climate of the region.

(9) Cable entry points in the location boxes shall be filled with sand and plastered with cement.

(10) Separate Location boxes shall be used for UP and DN line cables.

(11) Where too many location boxes (say more than 10) are in close proximity between Starter and Home signal, location huts may be provided instead of location boxes for security, proper protection and ease of maintenance.

(12) All location boxes shall be provided with 110 V AC lighting arrangement with ON/OFF switch to assist maintenance/repair work undertaken during night. Separate power cable shall be used to provide the lighting arrangement.

(13) The foundation of Location boxes shall not be done on loose earth. It should be installed on concrete foundation. The foundation drawing shall be proposed by the Contractor and approved by the Engineer.

5.3.23 Testing of cable

(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.

(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 relay room shall be done.

(3) If any defect is noticed during the testing after laying the cable the same shall be replaced.

(4) The insulation resistance tests shall be made when conductors, cables and insulated parts are clean and dry. A 500V 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.

(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.

5.3.24 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 and the Contractor’s authorized person before cable laying is undertaken. The record of joint inspection of the trench shall be maintained.

5.3.25 Earth Leakage Detector (ELD)

(1) ELD shall be provided to detect earth faults in the Signalling cables and circuits.

(2) ELD and alarms shall be provided at all the Signalling equipment rooms at the stations, block sections and at the OCC.

(3) ELD provided should cover all the Signalling cables and power cables.

5.4 Earthing and Bonding

5.4.1 General

(1) Earthing shall be provided for all Indoor &Outdoor Signalling installations to achieve the following objectives:

(a) 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.

(b) Provide a stable reference for electrical and RF circuits at the installation to minimize noise during normal operation.

(c) Protection of personnel who work within the area from dangerous electric shock caused due to “step potential” or “touch potential”.

(2) 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.

(3) 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.

(4) The Earthing and Bonding system shall meet or exceed the requirements of IEEE 1100, NFPA 780, IEC 62561-7 and IEC 62305.

(5) To minimize the effect of circulating earth loops and to provide equipotential bonding, “star type” bonding connection shall only be provided as required.

(6) 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.

5.4.2 Indoor Signalling installation

(1) The Equipment rooms housing Indoor Signalling equipment and their Power supply shall be provided with suitable Earthing and Bonding system. A typical Earthing and bonding arrangement for Indoor signalling installation is placed at Annexure-I of Appendix 6.

(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 bus bars (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).

(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.

(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.

(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.

(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.

(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.

(8) The Earthing system shall use maintenance free loop earth as per specification RDSO/SPN/197/2008 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.

(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.

(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.

5.4.3 Outdoor Signalling installation

(1) All the Outdoor Signalling equipment viz. Signals, Location boxes, Lifting barriers, track devices etc. shall be provided with suitable Earthing arrangement.

(2) All concrete foundations viz. Location boxes, signals, DPs, Point JB and others shall be painted with double coat white enamel paint duly approved by Engineer.

(3) 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.

(4) 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 specification RDSO/SPN/197/2008.

(5) 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.

(6) Where the equipment to be earthed are in close vicinity they should be connected to a common earth in star configuration.

(7) 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.

(8) GI wire as earthing bond shall not be used.

(9) A typical Earthing, Bonding and Surge protection arrangement for location boxes housing Electronic equipment is placed at Annexure-II of Appendix 6.

5.4.4 Lightning Protection

(1) All the structures housing Signalling and Telecom equipment viz. SER, TER and S&T Power supply Equipment rooms, shall be provided with lightning protection arrangements and protection against lightning surges travelling through conductors into equipment by using appropriate devices.

(2) The external Lightning protection arrangement shall have an air termination system, down conductors and Earthing system complete with accessories.

(3) The Lightning Air Terminal should be installed at a height at least 3m more than the top most projection of the building. In case there is a VHF antennae installed on the building, the lightning protection should be so designed to safely overcome the competing features of the antennae as well as any other higher projections on the building.

(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.

5.4.5 Surge Protection

(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.

(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.

(3) The Surge Protection System provided to withstand the surge voltages shall be complying with IEC standards 62305, 61643, 60364.

(4) Surge Protection for Indoor Signalling equipment shall be provided as under:

(a) **Stage 1 Protection (at the input 230V AC supply in the power supply equipment room)**

(i) 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. There shall be a voltage switching device and tested as per IEC 61643 with the following characteristics and features:

SN	Parameters	Limits	
		Between Line & Neutral	**Between Neutral & Earth**
1	Nominal Voltage (U_0)	230V	230V
2	Maximum continuous operating voltage (U_c)	≥ 255V	≥ 255V
3	Lightning Impulse current 10/350μs (I_{mp})	≥ 25KA	≥ 50KA
4	Response time (Tr)	≤ 100 ñs	≤ 100 ñs
5	Voltage protection level (Up)	≤ 2.5KV	≤ 2.5KV
6	Short circuit withstand and follow up current extinguishing capacity without back up fuse (I_{sc}&I_{fi})		
7	Temporary Over Voltage (U_T)	334Vmin. for 05 secs.	1200V min. for 200ms
8	Operating temperature / RH	- 25°C to + 80°C/ 95%	- 25°C to + 80°C/ 95%
9	Mounted on		din rail
10	Indication	Mandatory	Optional
11	Pluggability	Optional	Optional
12	Potential free contact for remote monitoring	Optional	Optional
13	Encapsulation	Encapsulated	Encapsulated
14	Degree of protection		IP20
15	Housing	Fire retardant as per UL 94	Fire retardant as per UL 94

(ii) 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: -

SN	Parameters	Limits (between Line & neutral)
1	Nominal Voltage (U_0)	230V
2	Maximum continuous operating voltage (U_c)	≥ 300V

SN	Parameters	Limits (between Line & neutral)
3	Nominal discharge current 8/20μs (In)	≥ 10KA
4	Maximum discharge current 8/20μs (Imax)	≥ 40KA
5	Response time (Tr)	≤ 25 ñs
6	Voltage protection level (Up)	≤ 1.5 KV
7	Operating temperature / RH	- 25°C to + 80°C/ 95%
8	Mounted on	Din rail
9	Indication	Mandatory
10	Pluggability	Mandatory
11	Potential free contact for remote monitoring	Mandatory
12	Degree of protection	IP20
13	Housing	Fire retardant as per UL 94

(iii) 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.

(b) **Stage 2 Protection (Power line protection at Equipment level)**

The Stage 2 protection shall consist of provision of Class II/ C type SPDs on 24V-110V AC/DC supplies at Equipment input level for protection against low voltage surges. The Class II/C type SPD shall be provided between Line to Neutral & Neutral to Earth. The device between Line to Neutral 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. The device between Neutral to Earth shall be a voltage switching device of proper rating. They shall be tested as per IEC 61643 with the following characteristics and features-

SN	Parameters	Limits	
		Between Line & Neutral	Between Neutral & Earth
1	Nominal Voltage (U_0)	230V	230V
2	Maximum continuous operating voltage (U_c)	≥ 300V	≥ 255V
3	Nominal discharge current 8/20μs (In)	≥ 10KA	≥10KA
4	Maximum discharge current 8/20μs (Imax)	≥ 40KA	≥ 40KA

5	Response time (Tr)	≤ 25 ñs	≤ 100 ñs
6	Voltage protection level (Up)	≤ 1.5 KV	≤ 1.5 KV
7	Operating temperature / RH	- 10°C to + 60°C/95%	- 10°C to + 60°C/95%
8	Mounted on	DIN rail	DIN rail
9	Indication	Mandatory	Optional
10	Pluggability	Mandatory	Mandatory
11	Potential free contact for remote monitoring	Mandatory	Optional
12	Degree of protection	IP20	IP20
13	Housing	Fire retardant as per UL 94	Fire retardant as per UL 94

(c) **Stage 3 protection (Protection for Power/ Signalling/ Data lines)**

(i) 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.

(ii) 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 (U_0)	5 V	12 V	24 V	48 V
Arrestor Rated voltage (U_c)	6 V	13 V	28 V	50 V
Rated Load current (I_L)	≥250 mA	≥250 mA	≥250 mA	≥250 mA
Total discharge current 8/20 µs (I_n)	≥20 kA	≥20 kA	≥20 kA	≥20 kA
Lightning test current 10/350 µs	≥2.5 kA	≥2.5 kA	≥2.5 kA	≥2.5 kA
Voltage protection level (U_p)	≤ 10 V	≤ 18 V	≤ 30 V	≤ 70 V

(iii) 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 5)

CHAPTER 6: TESTING AND COMMISSIONING

6.1 General

6.1.1 The general details of Testing and Commissioning Philosophy, Strategy, Program, Plan and procedures is covered in General Specifications, Volume 5 Part 2 Section V(A). The specific requirements of Testing and Commissioning covered here shall be read in conjunction with the general requirements covered in GS.

6.1.2 All costs associated with the testing shall be borne by Contractor. This shall include the Inspection/Testing Charges to be paid to RDSO/RITES/Test Laboratories/Third Party Independent Agency etc. 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.

6.1.3 **Sequence of Tests**

The sequence of tests shall generally comprise of the following:

(1) Type Tests, as and when required;

(2) Factory Acceptance Tests (FAT);

(3) Installation Tests;

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

(5) Integrated Testing & Commissioning; and

(6) Trial Run.

6.2 Type Tests

6.2.1 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.

6.2.2 Type tests on equipment for which RDSO specification exists, if required shall be done as per applicable RDSO specification.

6.3 Factory Acceptance Tests

6.3.1 The FAT is carried out to demonstrate that each equipment/sub-system meets its functional specifications.

6.3.2 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.

6.3.3 FAT procedure shall be submitted for review by the Engineer Twenty Eight (28) days in advance of carrying out any Test.

6.3.4 The FAT shall be witnessed by Engineer/Employer's representative. However, for items procured from RDSO approved sources and inspected by RDSO, the engineer can decide to wave off witnessing of FAT.

6.3.5 Where processor based equipment is to be used, the FAT shall also include verification of application software.

6.3.6 Factory acceptance tests shall include but not limited to:

(1) Physical inspection;

(2) Layout and equipment profile;

(3) Dimension check;

(4) Electrical check;

(5) Calibration;

(6) Output check;

(7) Operational performance;

(8) Insulation test;

(9) Soak test; and

(10) Interface tests with other equipment.

6.3.7 The EI application logic/software for every station and auto section 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 test at the FAT stage shall be identified and tagged for testing at SAT stage, in consultation with the Engineer.

6.4 Installation Tests

6.4.1 Prerequisites for Installation:

(1) Prior to installation, the Contractor shall ensure that equipment delivered to Site has not been damaged in transit and ensure for their dimensional accuracy.

(2) The Installation designs and drawings have been reviewed and approved by the Engineer.

6.4.2 Post Installation tests and Inspection:

(1) Post installation tests shall be carried out by the Contractor for each sub system following installation but before functional tests to demonstrate that the installation has been carried out correctly.

(2) 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.

(3) 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.

(4) During the inspection, it shall be verified that

(a) 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.

(b) Any false feed, temporary wiring and redundant items have been removed and that equipment is correctly protected against interference, damage and deterioration.

(5) 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.

(6) There shall be separate checklist for TMS, EI, MSDAC, IPS/UPS, Data loggers, Signals, Points machines, Cables, Location Boxes, earthing and Bonding etc. etc. Installation checklist issued by RDSO/OEM, where available shall be followed. The installation check list shall include Structure gauge checks to ensure the installations are carried out to the Schedule of Dimensions requirements;

(7) The Installation shall be inspected and witnessed by the Engineer/Employer's representative as per the Installation checklists and records 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 verified by the Engineer and recorded. The Installation inspection records and Installation checklists shall form part of Installation test records.

(8) These tests shall culminate in SAT to verify the correct operation of all apparatus and where appropriate, correct response to the respective control commands or monitored function.

(9) Installation Tests

(a) After installation of the equipment, Visual inspection on un-energized equipment shall be carried out to check the following:

(i) Cleanliness;

(ii) Workmanship;

(iii) Confirmation of items conforming to ratings specified;

(iv) Water and dust proofing;

(v) Levelling, mounting and positioning;

(vi) Joints and connections tightness;

(vii) Cables – dressing, bending radii, jointing and finish at terminals;

(viii) Clearances and dimensions in conformity with drawings and SOD;

(ix) Earthing and bonding;

(x) Layout and Equipment profile check.

(xi) Protection devices;

(b) The Visual inspection shall be followed by (but not limited to) further Installation tests as under:

(i) Voltage measurements;

(ii) Continuity test as per wiring diagram;

(iii) Cable Insulation testing;

(iv) Power cubicle function test;

(v) Wire continuity tests;

(vi) Earth value measurements;

(vii) Wire count tests;

(viii) Software is correctly installed with the correct version and checksum;

(ix) Circuit board is of correct version and is correctly installed;

(x) Strap and Function tests;

(xi) Through circuit function test of the equipment;

(xii) Signal Sighting tests;

(xiii) Functioning of circuit breakers, isolating switches and their interlocks;

(xiv) Interface tests with other equipment.

6.5 System Acceptance Test

6.5.1 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.

6.5.2 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

6.5.3 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.

6.5.4 Prerequisites for commencement of the System Acceptance Tests (SAT):

(1) All documentation for the System Safety report have been submitted to the Engineer for review;

(2) All Installation Tests have been completed and test records submitted to the Engineer for review;

(3) Facilities for the maintenance of the system are in place; and

(4) The SAT Plan has been submitted to the Engineer for review at least one hundred and sixteen (116) days before the commencement of the SAT.

6.5.5 Verification and Validation of Application logic

(1) 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.

(2) Tests shall be carried out on each Signalling function to ensure that all the controls specified in the Control tables are present and effective.

(3) It is permissible for the application logic to be verified by use of simulation systems. The extent of verification testing by simulation shall be defined in the Test plan.

(4) 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.

(5) Functions commonly requiring to be tested include, but are not limited to:

(a) El Hot standby tests;

(b) Point interlocking;

(c) Route interlocking;

(d) Sectional and sequential route releasing;

(e) Route initiation and setting;

(f) Approach locking;

(g) Train operated route release;

(h) Block controls;

(i) Level crossing controls;

(j) Emergency cancellations;

(k) Crank handle interlocking;

(l) Aspect sequence and cascading arrangement (horizontal and vertical).

(6) 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.

(7) 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.

6.6 Integrated Testing and Commissioning

6.6.1 Integrated Testing on Completion shall include the Work of other contractor(s). The Contractor shall, following satisfactory completion of tests on his works, equipment, sub-systems or system, perform, at the direction of the Engineer, Program of tests to verify and confirm the compatibility and complete performance of his works, equipment, sub-systems or system with the works, equipment, sub-systems or system provided by others.

6.6.2 The Contractor shall submit to the Engineer the requirements and procedures in respect of the Contractor's scope of work for Integrated System Tests in conjunction with the other contractors to demonstrate that the complete system provided under the Contract is fully operational and meets the specified performance criteria.

6.6.3 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.

6.6.4 Integrated testing and commissioning shall include the integration of the section (Deen Dayal Upadhyay-New Bhaupur) with the adjacent already commissioned sections including OCC, without disturbing the safety and revenue operation of the earlier sections.

6.6.5 Conducting of these Integrated Tests by the Contractor and the other contractors shall include a period of Trial Run.

6.6.6 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.

6.6.7 The results of the Integrated Testing and Commissioning shall be documented.

6.6.8 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.

6.7 Trial Runs

6.7.1 On completion of integrated testing and commissioning to the satisfaction of the

Engineer and System acceptance test, the Contractor shall confirm in writing to the Engineer that the works provided by him under the contract is ready for the Trial runs.

6.7.2 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.

6.7.3 The Trial run shall be made use for ensuring the following:

(1) Signal and indicators Sighting – approach sighting, focus, alignment, relationship with other signals, and interference from other sources of light (e.g. street lamps);

(2) Track Vacancy detection system operates correctly, reliably and continuously during presence/absence of a train; and

(3) Dynamic interfaces – Integrity of operation and indications across boundaries between different types of track vacancy detection equipment and between different interlocking;

(4) Checking for timing issues with level crossings;

(5) Confirmation that train describer stepping, and associated systems, works correctly, especially across boundaries;

(6) Specific types Signalling equipment could require a test train, especially where evidence of the correct operation of train / signalling equipment interfaces is required; and

(7) Verify the layout to the Signalling plan, as far as practicable.

6.7.4 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.

6.7.5 The Contractor’s personnel shall be available throughout the period of Trial run.

6.7.6 After the successful Trial Run and after obtaining statutory clearances / approvals from CRS/MD DFCCIL and or other relevant authorities, the Works shall be commissioned with the consent of the Engineer.

6.8 Statutory Clearances

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/MD DFCCIL.

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/MD DFCCIL sanction.

(End of Chapter 6)

CHAPTER 7: DOCUMENTATION

7.1 General

7.1.1 Requirements of Documentation in general are covered in General Specifications Part 2, Part 2, Section V(A). This chapter mentions particular requirements of Documentation for Signalling System.

7.2 List Of Documents

The documents to be supplied by the Contractor shall be, but not limited to, the following:

7.2.1 Management Plans

(1) Project plan
(2) Interface management plan
(3) Quality plan
(4) Safety plan,
(5) EMC management plan
(6) Construction & installation management plan
(7) Design plan (Including design verification & validation& design quality plan)
(8) Type testing & factory acceptance testing (FAT) plan
(9) Procurement, manufacture & delivery plan
(10) Testing& commissioning plan,
(11) Operation & maintenance plan
(12) Training plan
(13) Spare parts & consumable management plan
(14) Defect liability management plan
(15) Maintenance management plan
(16) Trial run plan

7.2.2 Preliminary Design Submissions:

(1) Design manual.
(2) System requirement specification
(3) Specifications of systems/ subsystems/equipment
(4) Identification of design codes and standards
(5) System Simulation Report
(6) Design Templates for Signal Interlocking Plan, Route Control Table, Detailed Design sheets etc.
(7) Preliminary System design
(8) Block diagrams showing information flow from site to station to OCC bringing out clearly the redundancies provided
(9) Signal Interlocking Plan (SIP) of one station and one block section
(10) Equipment proposal for Station, ALH, LC gate hut
(11) Equipment sizing for Station, ALH, LC gate hut
(12) Equipment layout Plan for Station, ALH, LC gate hut
(13) Preliminary Power Supply diagram for TMS
(14) Typical Power Supply diagram for Station, Auto location Hut, LC gate (away from ALH)
(15) Preliminary Power supply load calculation, for one Junction Station, one Crossing Station, Auto Location hut (with LC gates) , Auto Location hut (without LC gates)
(16) Preliminary climate management calculations. (Station/Auto location hut/LC gate

hut)

(17) Survey Reports
(18) Earthing, Lightning & Surge protection plan
(19) Typical Axle counter location plans showing both Main and supervisory sections
(20) Typical Cable Core plan for Station and Block section
(21) Typical Cable termination details for track side devices such as axle counters, points, signals, LC gates etc.
(22) Location Foundation drawings
(23) Signal Foundation drawings
(24) Migration Plan for Phased removal of Level crossing gates

7.2.3 Detailed Design submissions

(1) Signal Interlocking Plans of Stations and Block sections.
(2) Route Control tables.
(3) VDU diagram.
(4) Control cum Indication panel Diagram at LC gate.
(5) System configuration showing EI connectivity.
(6) Equipment Layout Plans – OCC, Signal Equipment Room, Power Supply room, LC/ Auto Location Hut, Location/Junction Boxes, SM office.
(7) Cable Core Allocation - Station, Block section.
(8) Cable Route Plan - Station, Block section.
(9) Power supply Load Calculation for Stations (Junction & Crossing).
(10) Power supply Load Calculation for Auto Location huts (without LC gates)
(11) Power supply Load Calculation for Auto Location huts (with LC gates)
(12) Circuit Diagrams/Wiring diagrams.
(13) Application Logic of Stations and Block sections.
(14) Equipment Rack details.
(15) Cable Termination Rack Diagrams.
(16) Fuse Details.
(17) Relay Contact analysis.
(18) Configuration data, parameters and settings.
(19) Interconnection details for all equipment in SER.
(20) Track devices termination details.
(21) Cable termination details of locations/Junction boxes.
(22) Station Working Rule Diagrams.
(23) Detailed Signalling Power supply distribution arrangement at OCC, Station, Auto Location Hut, LC gate huts.

7.2.4 System assurance submissions

(1) System Assurance Plan including
  (a) System RAM Plan and
  (b) System Safety Plan
(2) Safety policy
(3) Hazard Analysis and Hazard Log
(4) Design/System Safety Studies and Report
(5) RAM Analysis and Prediction Report
(6) FMECA
(7) RAM Demonstration plan.
(8) Engineering Safety Validation Report
(9) Operational Safety case

7.2.5 Operation and Maintenance Manuals

Please refer to Para 23.0 of General Specifications Volume 5 Part 2 Section V(A).

7.2.6 Documents for CRS/MD DFCCIL Sanction

Preparation of CRS/MD DFCCIL application along with supporting documents, including Station Working Rules (SWR), Gate Working Rule (GWR), SIPs, SWRDs, ESP, control table, approved special instructions/special instructions if any deviation from G&SR, and any other relevant document required for CRS/MD DFCCIL sanction.

(End of Chapter 7)

CHAPTER 8: SPARES, SPECIAL TOOLS AND TEST EQUIPMENT

8.1 General

8.1.1 The Contractor shall provide 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.

8.2 Supply of Spares

8.2.1 The Spare Parts to be supplied by the Contractor shall consist of:

(1) Commissioning Spares (as hereinafter defined);

(2) Defects Liability Spares (as hereinafter defined); and

(3) Contract Spares (as hereinafter defined).

8.2.2 Commissioning Spares

(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.

(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.

(3) The Contractor shall ensure availability of ‘Commissioning Spares’ on or before the commencement of any System Acceptance Tests (SAT).

8.2.3 Defects Liability Spares

(1) The Contractor shall keep sufficient stocks of 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").

(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 DNP, to the Engineer for review.

(3) The Contractor shall ensure availability of ‘Defects Liability Spares’ on or before the commencement of the DNP.

8.2.4 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:

(1) The expected failure rate of the parts.

(2) Population of the parts in the system.

(3) Criticality of the parts in the system.

(4) Availability and MTBF figures of the system.

(5) Spare delivery lead time.

(6) Workshop repair turnaround time.

8.2.5 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.

8.2.6 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. .

8.2.7 **Contract Spares**

(1) The Contractor's supply of 'Contract Spares' shall be for Employer's operation and maintenance need.

(2) Following 'Contract Spares' shall be supplied:

SN	Item	Unit	Quantity
1	Underground cable	Km	5% of the total cable laid subject to a minimum of 1 km of each type.
2	All other Cable & wires, other than Underground cables	M	5% of the total cable/ wire used / laid subject to a minimum of 100 meter of each type.
3	Power supply – cards, modules, equipment complete with interconnecting cables and connectors and all other associated accessories	Nos.	20% of each type installed subject to minimum of one.
4	Electronic Interlocking & Object Controllers (if any) – Control Terminal, cards, modules complete with interconnecting cables and connectors and all other associated accessories.	Nos.	20 % of each type installed subject to minimum of one.
5	Digital axle counter – cards, modules complete with interconnecting cables and connectors and all other associated accessories.	Nos.	20 % of each type installed. Subject to minimum of one card.
6	All rail mounted equipment complete with interconnecting cables and connectors and all other associated accessories.	Nos.	30% of each type installed. Subject to minimum of one.
7	VRLA batteries	Nos.	15% of each type installed. Subject to minimum of one.
8	Signals complete including Signal	Nos.	5% of each type installed. Subject to

SN	Item	Unit	Quantity
	posts, CLS units etc. Signal Lighting Units etc.		minimum of one.
9	LED Signal Lighting Units complete with current regulator, interconnecting cables and connectors and all other associated accessories.	Nos.	20% of each type installed. Subject to minimum of one.
10	Point machines including ground connections	Nos.	15% of each type installed. Subject to minimum of one.
11	Train Management system including networking equipment (except Server) and Video Walls at OCC, TMS terminals, FIU along with interconnecting cables and connectors and all other associated accessories.	Nos.	15% of each type installed. Subject to minimum of one.
12	Service & Diagnostic 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.	Nos.	15% of each type installed subject to minimum of one.
13	Electric Lifting Barriers	Nos.	100% of the total installed
14	MCB, surge protection device, fuses & terminals	Nos.	15% of each type installed. Subject to minimum of one.
15	All other interconnecting cables/ connectors not included above	Nos.	10% of each type installed. Subject to minimum of one.
16	Other items/equipment/ material which are not included above	Nos.	15% of each type installed subject to minimum 2 Nos.

(3) 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 higher deliverable unit.

(4) The List shall include information on make, model, serial number, 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 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.

(5) The Spare Parts shall be manufactured at the same time as the Permanent

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 Part 2, Section V(A), General Specifications. Test certificates for each piece or set of equipment shall be submitted to the Engineer.

(6) Before the Spare Parts are delivered, the Contractor shall submit to the Engineer a shipment advice notifying details of shipment such as date of dispatch, vessel 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.

(7) The Contractor shall complete supply of the 'Contract Spares' on or before start of Defects Notification Period.

(8) The Contractor shall indicate the sources of supply of all 'Spares' and shall guarantee their availability during the design life of the project.

(9) 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.

8.2.8 Special Tools and Test & Measuring Equipment

(1) FollowingTools &Test equipment shall be supplied:

SN	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 & 500V. All the tools shall be from reputed manufacturers and shall be supplied in a suitable carrying case. (all measuring tools calibration certificate with validity shall be submitted along with measuring tools)	Nos.	25
2	Megger 500/ 1000V AC 0 to 200 M ohms with earth tester, electronic push button type of Philips or any other reputed make	Nos.	25
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.	Nos.	25
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.	Nos.	25

SN	Item	Unit	Quantity
5	Supply of electric drill machine of size 6 mm and other description as per 4 above.	Nos.	25
6	Digital earth tester, 4 terminal, range 0-10/ 100 ohms with rechargeable battery complete with other required accessories in a suitable carrying case.	Nos.	25
7	Laptop based mobile maintenance terminal (uploaded with general and special software required for maintenance and diagnostic for EI, MSDAC, SSDAC, BPAC, UFSBI etc. as decided by Engineer)	Nos.	25
8	Complete tool kit for maintenance of EI as per the recommendations of the manufacturer in a suitable carrying case.	Nos.	1 at each EI
9	Complete tool kit for maintenance of DAC as per the recommendations of the manufacturer in a suitable carrying case.	Nos.	1 for each Evaluator of MSDAC.
10	Complete tool kit for maintenance of IPS as per the recommendations of the manufacturer in a suitable carrying case.	Nos.	1 for each IPS.
11	Special tools, test equipment including access ladders and protective gear for maintenance of gantry mounted signals if installed.	Set	10 sets
12	Computer based test set up with required software for automatic testing like 'Functional Testing',Simulation testing as per control table, Square sheet test etc.	Nos.	Min. 2 Nos.
13	DC Clamp meter (Fluke Make model No. 325 or Similar as approved by Engineer)	Nos.	2 no. for each EI.
14	Rail hole drilling Machine (BDS make model Rail MAB 925 or Similar) for Axle Counter with accessories with Portable Generator set of suitable capacity for Operating Rail MAB 925 & MAB 825 Drill Machine as advised by Axle Counter OEM and approved by Engineer.	Nos.	1 no. for each EI.
15	Switch Rail hole drilling Machine (BDS Make Model MAB 825 or Similar) for Point Machine with accessories as advised by Point Machine OEM and approved by Engineer.	Nos.	1 no. for each EI.

(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. The Contractor shall make his own arrangement of Special Tools and Test equipment for use during Installation and Defects Notification Period.

(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.

(4) The List shall include information on make, model, serial number, rating, description, part number, drawing number, details of calibration etc. of each item of 'Special Tools and Test equipment'.

(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.

(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.

(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 Part 2 of General Specifications, consigned and delivered in accordance with the Engineer 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 by the start of DNP.

(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.

8.2.9 The Contractor shall set up an off-line Testing platform at a suitable place provided by the Employer. The Test platform shall consist of all sub systems of Signalling in minimum configuration, inter connected together. The Testing platform shall have the capability to test Signalling equipment/components/sub systems of EI, MSDAC, TMS, IPS/UPS etc. The testing platform shall be commissioned before revenue operations.

8.2.10 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 8)

CHAPTER 9: DEFINITIONS AND ABBREVIATIONS

9.1 Definitions

9.1.1 **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.

9.1.2 **Auxiliary signals:** Shunt signals – Independent or below Main signals, Calling-on signals, Route indicators, 'A' marker & 'AG' marker lights for Semi-Automatic signals.

9.1.3 **Control Terminal:** An Industrial grade computer complete with hard disc, VDU display monitor, key board and mouse, provided with SM.

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

9.1.5 **Failure:** A failure is an event which causes loss of function or performance within any part of the Signalling & Train Control System and requires a maintenance intervention to restore full functionality and performance.

9.1.6 **Flank Protection:** Protection of a train running on route set for it from trains or vehicles on neighbouring lines through setting & locking of concerned points in required position.

9.1.7 **Fouling Point: Th**e position at the convergence of two tracks where the kinematic envelopes, one on each line, would come into contact.

9.1.8 **Graceful Degradation:** The transfer in quality **or performance** from the initial level to a lower operable level.

9.1.9 **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.

9.1.10 **Independence:** The isolation between the investigating technician undertaking the work and a second person for example, responsible for checking or approving the work.

9.1.11 **Level Crossing:** Is the rail – road surface crossing.

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

9.1.13 **Main running signals:** Home signal, Starter signal, Intermediate Starter signal, Advance Starter signal and Gate signals.

9.1.14 **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.

9.1.15 **Mean Time Between Failures (MTBF):** The average time between failures causing service delays for a piece of equipment, a system or a subsystem.

9.1.16 **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.

9.1.17 **Reliability:** The probability that an item/equipment/system can perform a required function under given conditions for a given time interval.

9.1.18 **Running Lines:** The DFCCIL Running lines between Deen Dayal Upadhyay and New

Bhaupur.

9.1.19 **Safety:** Freedom from unacceptable risk.

9.1.20 **Sub system:** Each system comprising Signalling system. E.g. EI sub system, TMS sub system.

9.1.21 **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 junsdiction.

9.1.22 **TMS terminal:** A terminal having MMI device with video display unit (VDU), Keyboard and mouse.

9.1.23 **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.

9.1.24 **Track Section:** A Section of track between two DPs used for controlling the signal depending upon its clearance or otherwise

9.1.25 **Video wall:** A graphical representation of the railway and its global operating status.

9.1.26 **Vital Relay :** The Relays used for vital equipment such as Signal, Point, Track detection etc. whose correct operation is essential to the integrity of the signalling system.

9.1.27 **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.

9.2 List Of Abbreviations

ABS	Automatic Block Signalling
AC	Alternating Current
ACO	Automatic Change over
ACTM	Alternating Current Traction Manual
ALH	Auto Location Hut
AT	Auxiliary Transformers/ Auto Transformer
CB	Circuit Breaker
CD	Compact Disc
CENELEC	European Committee for Electro Technical Standards (ComitéEuropéen de Normalisation Electro technique).
CIU	Central Interlocking Unit
CMS	Crew Management System
CST	Civil, Structures and Track
CTC	Centralized Traffic Control
CTR	Cable Termination Rack
DAC	Digital Axle Counter
DG	Diesel Generator
DN	Down Direction
DP	Detection Point
DNP	Defect Notification Period
DLP	Defect Liability Period

ELD	Earth Leakage Detector
EI	Electronic Interlocking
ELB	Electric Lifting Barriers
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
EN	Euro Norm
FIU	Field Interface Unit
FMECA	Failure Mode Effects and Criticality Analysis
FRACAS	Failure Reporting and Corrective Action System
G&SR	General and Subsidiary Rules
GCC	General Conditions of contract
GPS	Global Positioning System
HDD	Hard Disc Drive/ Horizontal Directional Drilling
HDPE	High Density Poly Ethylene
Hz	Hertz
I/O	Input / Output
IEC	International Electro–Technical Commission
IEEE	Institute of Electrical and Electronics Engineers
IMD	Integrated Maintenance Depot
IMSD	Integrated Maintenance Sub Depot
IPS	Integrated Power Supply
IRPWM	Indian Railway Permanent Way Manual
IRSEM	Indian Railway Signal Engineering Manual
ISA	Independent Safety Assessor
ISO	International Standards Organization
Km / KM	Kilo Meter
KVA	Kilo Volt Ampere
LAN	Local Area Network
LED	Light Emitting Diode
LC	Level Crossing
LRU	Lowest Replaceable Unit
LV	Line Verification
LVR	Line Verification Relay
MACLS	Multiple Aspect Colour Light Signalling
MIS	Management Information System
MCB	Miniature Circuit Breaker
MMI	Man Machine Interface
MSDAC	Multi Section Digital Axle Counter
MTBF	Mean Time Between Failure
MTTR	Mean Time To Restore

MTBSAF	Mean Time Between Service Affecting Failure
NMS	Network Management System
NDA	Non-Descript Alarm
OCC	Operations Control Centre
OEM	Original Equipment Manufacturer
OFC	Optic Fibre Cable
OHE	Over Head Equipment
PC	Personal Computer
RAM	Random Access Memory
RAMS	Reliability, Availability, Maintainability and Safety
RE	Railway Electrification
RSTR	Reset Relay
SCADA	Supervisory Control and Data Acquisition
S&D	Service and Diagnostic
SOD	Schedule of Dimension
SER	Signalling Equipment Room
SP	Sectioning Point
SPAD	Signal Passed at Danger
SSDAC	Single Section Digital Axle Counter
TDS	Train Describer System
TMS	Train Management System
TPC	Traction Power Controller
UPS	Uninterruptible Power Supply
UFSBI	Universal Fail Safe Block Interface
UP	Up Direction
VDU	Video Display Unit
VRLA	Valve Regulated Lead Acid

(End of Chapter 9)

CHAPTER 10 – TRAINING

10.1 Scope of Training

10.1.1 The objectives of this training are as under:

a) to enable the Employer's operation & maintenance personnel to operate, maintain & carry out alterations, if need be, in the commissioned signalling system and

b) to enable the Employer's Key Instructors to be competent to deliver future courses for other employees of the Employer.

10.1.2 The training shall be imparted on various Systems. Aspects covered shall include, but not be limited to, the following:

a) Operating features and functional principles of the relevant Systems;

b) System engineering aspects including but not limited to design standards, design criteria and parameters, short-circuit and other calculations ,insulation and protection co-ordination;

c) Details of major equipment and components used in the System;

d) System installation, operating and maintenance management procedures.

e) Control and monitoring systems for each System.

10.2 General Requirements

10.2.1 This section of the specification covers the requirements for a Training Programme to train the Employer's maintenance, operating and training personnel. The Training Programme shall enable the basic staff to operate, service, enhance, maintain and interact with the hardware, software and firmware such that the systems and associated equipment will perform in accordance with the specifications of this contract.

10.2.2 The Contractor shall provide comprehensive training to the Employer's maintenance, Operating personnel and Key Instructors.

10.2.3 The contractor shall provide competent training instructors, training manuals, all necessary aids and materials in support of all training courses. In addition to supply of printed manuals to all trainees, the training manuals shall be submitted in original plus ten (10) hardcopies and in electronic format to the Engineer.

10.2.4 The training instructors shall be qualified and competent with sufficient years of practical experience in the relevant fields and possess good communication skills. The training instructors shall be competent staff of the Contractor, the sub-contractors or the equipment manufacturers.

10.2.5 Training shall be conducted in English Language. The respective training manuals will be provided in English. If asked by Engineer, the training manuals will be provided in Hindi also.

10.2.6 The training shall be carried out at site or in DFCCIL Corporate/Regional office .The cost of travel and boarding/lodging of Employer's personnel shall be borne by DFCCIL.

10.2.7 The training courses and/or sessions shall include system performance requirements and all major equipment and works engineered by the Contractor.

10.2.8 The Contractor shall provide full-time on-Site management, co-ordination and supervision of the entire training programme to ensure the continuity of classes and proper distribution of training materials and be responsible for interfacing with the instructors.

10.2.9 The Contractor shall be required to arrange training to the Employer's staff in respect of design, installation, testing and commissioning of the System and each subsystem.

10.3 Training Plan

The Training Plan shall be prepared by the Contractor and submitted to the Engineer for review. The Training Plan shall include, but not be limited to, the following:

(a) The program of the training courses and submission schedule of the training materials;
(b) Over view and description of objectives of each training course.
(c) the location where the training courses to be conducted;
(d) Set ups for practical exercises.
(e) The Contractor's training organization, chart, including the role and responsibilities of individual key persons;
(f) The qualifications and experience of the training instructors;
(g) Details of training simulators to be provided or developed, if applicable.

10.4 Training Courses

10.4.1 The Contractor shall provide Training Courses on all facilities, systems, equipment, hardware, firmware and software. Each Course shall be specific and shall consist of class room, 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

10.4.2 The technical training courses to the Employer's staff shall be programmed in phase 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.

10.4.3 The Contractor shall provide training courses for each of the sub-systems including but not limited to:

(a) EI
(b) IPS
(c) Track Vacancy Detection Systems
(d) TMS/CMS.
(e) Data Logger
(f) Point Machines
(g) ELD

10.4.4 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.

10.5 Operating Staff Courses

10.5.1 The operating staff training courses shall be developed to provide all necessary knowledge and skills for operating staff of the Employer to operate the system under normal, degraded and emergency situations and recovery from minor or simple faults. In particular, the training course shall include the following as minimum

(a) Overview of the relevant System.
(b) Description of the operation principle of all Systems and Subsystems
(c) Description for operating technical equipment
(d) Operational features and functions
(e) Reading and interpretation of system status and alarm messages or indications
(f) Normal and degraded operating procedures
(g) Operating procedures under emergency situations;
(h) Procedures for recovery from minor or simple faults;
(i) Use of operating and Maintenance Manuals and documentation;
(j) Detailed knowledge and correct application of operating rules and procedures and
(k) Local knowledge of stations and the line.

10.5.2 Particular exercises shall be included in the operating training course for each trainee to operate and manage the system under normal and emergency operating conditions and simple fault recovery.

10.6 Maintenance Staff Courses

10.6.1 The maintenance staff courses shall be developed to provide all necessary knowledge and skills:

(a) To perform full maintenance, including both preventive and corrective maintenance on each System and
(b) To perform system Engineering management including system parameter configuration, enhancement, adjustments and provision of new equipment and components.

10.6.2 Training shall be provided on all aspects of Maintenance of the System including proprietary or third party equipment and software. Software shall also cover custom-designed software or software driven utilities to form part of the Preventive and Corrective Maintenance Procedures.

10.6.3 Level & Types of Maintenance

(a) Preventive maintenance means routine or scheduled maintenance requirements that must be performed on the system (including overhaul) to ensure that the operation of the system is maintained.
(b) Corrective maintenance means unscheduled troubleshooting maintenance requirements that must be performed on the system so that the system can be returned to normal service as soon as possible.
(c) First level maintenance means corrective maintenance procedures that must be performed on site so that the system can be restored back to normal service as soon as possible.
(d) Second level maintenance means corrective maintenance procedures that are implemented at workshop level to restore individual components and parts back to normal operation as soon as possible.

10.6.4 Training shall be based upon a ‘two -stage’ concept as follows:

(a) Stage one shall consist of training on the basic concepts and principles. These shall include system configuration, system specification, system operation & control, preventive maintenance procedures, troubleshooting/repair concepts, interpreting diagnostic test reports and equipment or system test & restoration.
(b) Stage two shall consist of on-the-job training on Preventive and Corrective Maintenance.

10.6.5 The Contractor shall determine the contents of the courses and the courses shall include the following as minimum

(a) Overview of the relevant System
(b) System features and functions
(c) Operating principles
(d) Description of system components
(e) Test and commissioning procedures
(f) Use of test equipment and special tools
(g) Reading and interpretation of alarms, indications, messages and print-outs
(h) Preventive maintenance procedures
(i) Fault diagnosis, trouble shooting and corrective maintenance procedures
(j) Equipment settings and parameters configuration
(k) Use of equipment manuals, operating and maintenance manuals, circuit diagrams and wiring schematics
(l) Methods and procedures to provide new circuits, system expansion and enhancement
(m) Data, software backup and loading
(n) Use of software such as peripheral control and configuration, utility, database structure, generation and modification.

10.6.6 Practical exercises shall be provided for each trainee to practice the following as minimum:

(a) use of test equipment and special tools;
(b) Preventive maintenance;
(c) Faultdiagnosisandtroubleshootingwithinducedfaultssetbytheinstructortosimulatereal-life situation and
(d) Faulty modules or cards replacement and restoring the system to normal operation.

10.7 Training Materials

10.7.1 Training Aids, Training Materials and Training Devices shall be of durable construction and shall become property of the Employer on completion of Training.

10.7.2 The Contractor shall provide all Training Aids, Training Materials, Training Devices, Special Tools, fixtures, models, or other equipment required to train the Employer's maintenance staff and Instructors.

10.7.3 The Contractor shall prepare Training Manuals and submit them to the Engineer for review at least 90 days prior to the start of the Training Demonstration.

10.7.4 Throughout the Contract, it shall be the responsibility of the Contractor to supply all changes and revisions of the Training Manuals to the Engineer.

10.7.5 Training Manuals shall become the property of the Employer.

10.7.6 The Employer reserves the right to copy all Training Materials for use in Training Courses.

10.7.7 All the training materials shall be accurate and match with the actual design of the System.

10.8 Training Period

100 trainer man days training shall be provided in India. Class size shall be a maximum of 30 trainees.

10.9 Training Records

10.9.1 The Contractor shall keep attendance records of trainees. The Contractor shall devise a system and standards in assessing the level of knowledge, understanding of the course content and proficiency of the trainees. The system and standards shall be submitted to the Engineer for review at least four weeks before commencement of the training course.

10.9.2 The Contractor shall issue appropriate training certificate to the trainees who pass the assessment.

10.10 Course Evaluation

10.10.1 The Contractor shall develop questionnaires to trainees for each training course in determining the level of satisfaction with the course content. Appropriate scoring weighting shall be assigned to each question in the questionnaires such that the scores shall reflect the trainee's satisfaction to the training course. The questionnaires shall be submitted to the Engineer for review four weeks before the commencement of the training course.

10.10.2 Upon completion of each training course, the Contractor shall distribute the questionnaires to the trainees to fill in.

10.10.3 The Contractor shall submit a training report to the Engineer for review within two weeks after completion of each course. The training report shall include a summary of the training course conducted, the results of trainees' assessment and the course evaluation questionnaires.

10.10.4 The contractor shall submit the course evaluation criteria one month before start of the training to the Engineer for approval.

End of chapter

Appendix 1

Working Methodology for Operation of LC Gates

(Extract of NCR's letter no. : NCR/S&T/8310/DFCCIL/PT-2 dated 02.01.2019)

1. PROPOSED WORKING METHODOLOGY OF LC GATES OF IR FALLING IN PARALLEL ALIGNMENT WITH EDFC-2 AFTER BEING INTERLOCKED WITH ABSOLUTE BLOCK SIGNALLING SECTION OF IR AND EDFC-2.

Operation of Level Crossing gates when EDFC and IR tracks are on the Parallel Alignment and Automatic Block System of Working is in force on EDFC and Absolute block signaling working is in force on IR and the Level Crossing Gate is Interlocked with EDFC and IR System and Normal position is 'OPEN' to road traffic.

1.1 Level Crossing Equipment

Single set of electrically operated common Lifting Barriers along shall be provided outside of IR and EDFC tracks. In addition to Lifting Barriers one additional Sliding Boom on each side of power operated lifting barrier will be provided and each Sliding Boom will be parallel to the existing power operated Lifting Barrier and will be installed such that the complete body of the boom is laying away from the road. The Sliding Booms installed are meant to be used in the case of emergency when the power operated lifting barrier are damaged or closed indication is not found due to any reason. Alternative arrangement of safety chain with Padlock also available to protect IR & EDFC tracks in case of emergency, when power operated lifting barrier and Sliding Booms are damaged/not functioning.

1.1.1 Control Cum Indication Panel (CCIP)

It is provided with following Controls/Indications (PS Signalling Works Clause 2.2.6 (1)(k))

(1) IR SECTION

a) ON & OFF aspects indications of UP & DOWN Gate Signals.

b) Switch/Button will be provided to take off the gate signal in absolute territory of IR lines as per existing system.

(2) EDFC SECTION

(a) UP and DOWN Train Approach Warning indications separately provided on the respective track **(6 kms).**

(b) LC gate approach locked indications separately for UP & DOWN lines (from **4KM).**

(c) Push buttons to acknowledge approach warnings for UP & DOWN lines.

(d) OFF & ON aspect indications (including A & AG markers) of UP & DOWN Gate Signals.

(e) Gate Replacement Track Indications for UP & DOWN lines.

(3) COMMON CONTROL AND INDICATIONS

(a) OFF & ON indications of Road Signals.

(b) Two position Rotary Switch to raise the Gate Signals to ON in emergency is provided with sealing arrangement inside a wooden box with front cover of glass & mounted suitably on the wall of Gate Lodge (for Gates in Station Sections).

(c) Two position Road Signal Switch to raise the Road Signals in case of Emergency and also before the closing the Sliding Boom.

(d) Sliding Boom Close Indication.

1.1.2 Emergency Key for Manual Operation of Lifting Barriers

Emergency Key for Manual Operation of Lifting Barriers is provided in the gate lodge with the following arrangement: (PS Signalling Works Clause 2.2.6(1)(m))

(1) Crank handle with key for manual operation of gate in case of power failure is kept in a sealed glazed box in gate lodge.

1.1.3 Electrical Key Locking Equipment (KLR) of Sliding Boom

Electrical Key Locking Equipment (KLR) is provided in the gate lodge with the following arrangement:

(1) Electrical Key Locking Equipment to lock key after closing the Sliding Boom.

(2) Push Button to release the key for opening the Sliding Boom.

1.1 4 Gate Operating Panel — (Outdoor)

A Gate Operating Panel - Outdoor is provided at a suitable location at the LC gate that provides clear visibility for the Gateman of approaching road traffic. The Gate Operating Panel-Outdoor is provided with following indications and buttons.

(1) Two indications, one indication for the 'Open' and one for 'Close' condition of the Barriers.

(2) Two Push buttons are provided, one for the Closing and one for Opening the Barriers.

(3) Indication for availability of power for motor operation of the Barriers.

1.1.5 Road Traffic Signals

Road traffic signals are provided on tubular posts on each side of the LC gate for road users at a suitable location so as to be visible clearly to the approaching road vehicles. The road traffic signals shall show the following aspects: (PS Signalling Works Clause 2.2.6(1)(h) & 2.2.6(2)(i))

(1) Steady Red aspect to indicate the "CLOSE" when gate closed for Road users.

(2) Steady Yellow aspect to indicate the "OPEN" condition of the Road Barriers.

(3) Flashing Red Aspect to indicate the Gate Barriers are in the process of being closed.

(4) Steady Yellow Aspect to indicate the Gate Barriers are in the process of being opened.

1.1.6 In case of Emergency Gateman will put the road traffic signal to "RED" aspect by turning road signal switch to reverse position provided on CCIP. (PS Signalling Works Clause 2.2.6(1)(l))

1.1.7 Hooters

Hooters, mounted on Road Signal posts, working in conjunction with the road signals, are provided at the LC Gate to warn the road users of the imminent closing/opening of the Barriers. The hooters shall cease sound when the Barriers are fully closed or fully opened.

1.1.8 Electrically Operated Boom Barriers

The Boom Barriers to be used will comprise of ELB boom barrier mechanism with Barrier Pedestal & Boom lock posts. The Barriers are fitted with a Stop Board, Boom Light box and MS counterweights. When closed, each boom barrier will rest on a Boom Barrier post and be locked in closed position by a boom solenoid locking system/motorized Locking system. (PS Signalling Works Clause 2.2.6(2)(c))

1.1.9 Sliding Boom Barriers

The Gate is provided with one additional Sliding Boom on each side of power operated lifting barrier. Each Sliding Boom will he parallel to the existing power operated Lifting Barrier of its side and would normally so positioned that the complete body of the boom is laying away from the road and padlocked i.e. no part of the Sliding Boom shall normally project on to the road leading to the L.C. gate. The Sliding Booms installed are meant to be used in case of emergency when the power operated Lifting Barriers are damaged or close indication not found due to any reason. These are normally locked on its post, with padlock. The Keys inside the locks provided on Boom stands. (PS Signalling Works Clause 2.2.6(1)(o)).

1.1.10 Safety Chains

Safety Chains are provided on each side of road to block the road traffic in case of failure/damage of ELB and Sliding Boom Barriers. One End of Safely chain shall be permanently welded to the post and other end shall be with locking arrangement with post on other side of road.

1.1.11 Telephone

(1) Selective Calling telephone is provided at LC gate to communicate with SM/EDFC. (PS Signalling Works Clause 2.2 6(1)(n))

(2) Existing Magneto telephone will be shifted from Existing Gate Lodge to New Gate lodge to communicate with SM/IR.

1.2 Method of Closing and Opening the Electrically Operated Gate

(1) Whenever any train is to be dispatched towards the Level Crossing the SM/EDFC or SM/IR station shall advice the Gateman of Level Crossing No. XX about the train number, description direction and likely time of passage of the train.

(2) (a) When the train is on IR track, the SM of IR will inform the gate man to close the gate as per existing practice.

(b) When the train is on DFCC track and reaches a predetermined point of 6 kms in rear of the Gate, a buzzer will start sounding in the Gate lodge intimating the gate man of the approach of a train. The Gateman shall acknowledge the concerned buzzer and the Gateman shall thereafter get ready to close the Gate in time against the road traffic for the passage of the train. If the Gate is already in closed position, the buzzer shall not sound but an indication shall be displayed in the CCIP. (PS Signalling Works Clause 2.2.6(1)(i)

(3) The Gateman shall then press the Gate closing push button on the Gate Operating Panel - Outdoor to close the gate for road traffic. The electrical lifting barrier booms will start lowering and as soon as the lowering of booms is started, the road signals shall start displaying a Steady Red light towards the road users and Hooter will also start sounding. After lowering of the booms fully, the Barriers get locked automatically by electrical lock provided on the boom locking post. Barriers Close indication will be lit and hooters will stop sounding.

(4) After fully lowering of booms, the Gateman has to turn the Gate Control Switch to Reverse position by ensuring that the Gate is clear of any road vehicles.

(5) The Gate man will take off the gate signal by means of switches/button as per existing system provided on CCIP for the trains on IR track. For EDFC signal will come off automatically after gate control switch is turned to reverse position.

(6) After passage of the train and gate signals have been put back to ON, the gateman will turn the Gate control switch to Normal position. Now gate can be opened after a time

delay of 120 seconds and gate free indication received on CCIP then he will proceed to gate operating panel and operate "Open" push button. The Boom Barriers start going up and when the barriers are 2° from the horizontal the road signals display flashing Yellow. When the Barriers are at 85° from vertical position Road Signals display Steady Yellow aspect.

Note:

a) When UP OR DOWN "Approach warning" light is lit on the CCIP, it is advised not to open a closed Gate.

b) In case of emergency it is possible to open the LC Gate even though the LC gate is approach locked. It may be opened after putting back the Gate Signals to danger as per para 1.2 (6).

1.3 Method of Operation of Gate by using Sliding Boom

The Gate is provided with one additional Sliding Boom on each side of power operated lifting barrier. Each Sliding Boom will be parallel to the existing power operated Lifting Barrier of its side and would normally so positioned that the complete body of the boom is laying away from the road and padlocked i.e. no part of the Sliding Boom shall normally project on to the road leading to the LC Gate. The Sliding Booms installed are meant to be used in case of emergency when the power operated Lifting Barriers are damaged or close indication not found due to any reason. These are normally locked on its post, with padlock. The Keys inside the locks provided on Boom stands (PS Signalling Works Clause 2.2.6(1)(o))

1.3.1 Mode of operation for closing the gate by the Sliding Boom

The Gateman, after getting specific instruction from SM on duty of IR / EDFC controlling station, will restrict the road traffic by closing the Sliding Boom. During this process he will put back road signal to danger by turning the Gate signal switch close on Gate Operating Panel — Outdoor then he will slide the Sliding Boom on EDFC track side by pulling the handle to close position up to stand provided for the purpose. He will insert the chained key in the boom stand lock and lock it; a key marked 'X' will be released, thereafter he will go to the IR track side and by pulling the handle to close position of the Sliding Boom up to its boom stand, will insert the chained key marked 'Y' in the boom stand lock and lock it. Also insert the 'X' key in the lock marked 'X' and turn clockwise in boom lock stand. After locking both keys, a 3rd key ‘Z’ will be released. The Gateman will take the key, apply it to the KLR fitted in the Gate lodge and turn it. Now Gateman turn the Gate Control Switch to reverse position after ensuring that there is no vehicle in between the Sliding Booms.

Sliding Boom Barrier closed indication will appear on CCIP and Gate Signals will come to caution aspect automatically.

1.3.2 Mode of operation for opening the Gate by the Sliding Boom

For opening of the Sliding Boom after passage of the train/trains, gateman will get specific permission from SM on duty of both IR & EDFC stations to open the Sliding Boom to clear the road traffic. After getting permission from both SMs, Gateman will take out 'Z' key from KLR apply it in Sliding Boom of ‘Z’ lock and adopt procedure in reverse order of closing the Sliding Boom to clear the road traffic.

1.4 Method of Operation of Gate by using Safety Chain

1.4.1 Mode of Operation for closing the gate by use of the Safety Chain

If gateman is not able to pull the sliding boom due to any failure/damage, safety chain can be used to block the road traffic.

During this process gateman will first put the road signal to RED aspect by turning the road signal switch then he will use the safety chain by pulling the Chain to other end of the road and pad lock the safety chain with the post provided for this purpose. There after he will go IR track side and use the safety chain across the road up to the post and pad lock with the post. He will keep both the pad lock keys in his custody. In this case no signal will come to off and working of trains shall be governed as DFCR GR 216.

1.4.2 Mode of Operation for opening the gate by use of the Safety Chain

For opening of the Safety Chain after passage of the train/trains, gateman will get specific permission from SM on duty of both IR & EDFC stations to open the Safety Chain to clear the road traffic. Thereafter he will turn the gate signal switch to normal to throw the gate signal to yellow.

1.5 Failure of Telephonic Communication

When telephonic Communication provided at LC gate for communication with IR stations or EDFC station fails or SM does not get any response from the Gateman despite 2 or 3 attempts following procedure should be adopted.

(1) The Station Master at the dispatching end shall issue a caution order to the Loco Pilot before dispatching a train in the Automatic block section from his end.

(2) Station Master shall advise the Loco Pilot to whistle continuously and proceed cautiously while approaching the gate.

(3) In case the gate signal is 'ON' Loco Pilot should stop short of the gate signal and follow the procedure laid down under DFCR GR 216

(4) In case of an approaching train, the Station Master shall advise the SM at the other end, under exchange of private number that the telephone at the gate has failed.

(5) Station Master should also advise S&T staff responsible for maintenance of the telephone to rectify the same at the earliest.

(6) Normal working will be resumed only after S&T staffs rectify the telephone and issue reconnection/fit memo for the same

1.6 Failure of Electrical Operation of Lifting Barrier

(1) When the Gate cannot be close/open due to failure of power operation of Lifting Barriers the Gateman will immediately inform the SM IR & DFCC on duty, under exchange of private number,

(2) Station Master should advise S&T staff responsible for maintenance of the Lifting Barriers to rectify the same at the earliest.

(3) Gateman will record the date and time with reason for taking out the crank handle from sealed box to close/open the gate as the case may be.

(4) After manually closing/opening of the Gate, the Gateman shall keep the crank handle key back in its position and inform the SM on Duty and S&T staff to seal the Crank Handle box.

(5) Normal working will be resumed only after S&T staffs rectify the Lifting Barriers and issue fit memo for the same.

1.7 Obstruction at the Gate

(1) **If** the Gate is broken by **a** road vehicle which is fouling the track, or if Lifting Barriers or any other part of the Gate foul the track, or if there is any other obstruction at the Gate, the Gateman shall immediately put back gate signal to danger as described in para 5.10 and then fix Red banner flag by day and flashing Red lamp by night on posts provided at both ends of the Gate for this purpose.

(2) Immediately after this, the Gateman shall advise the SM IR/DFCC on duty regarding the defects/obstructions at the gate, under exchange of private number.

(3) SM on duty shall be advised to put the reception / departure signals back to 'ON' position it taken "OFF" for a train.

(4) If there is no response from the SM after two or three attempts, he shall first protect the Gate and then inform on phone.

(5) Gateman shall then rush with detonators and Red flag by day and flashing Red hand signal lamp by night in the direction of the Approaching train and protect the Gate as stipulated.

(6) There after he shall protect the Gate from the other direction.

(7) Gateman shall note down the particulars of the road vehicle, name of the driver, owner and relay these details to the Station Master of IR/DFCC not to start the train unless they have been assured by the Gateman that the road vehicle or the Lifting Barriers are not fouling the track.

(8) The Station Master shall also inform the Station Master at the dispatching end, under exchange of private number, asking him not to dispatch any train in the block section from his end, until the track has been cleared of all obstruction.

(9) After the track has been cleared of all obstructions the Gateman shall inform the Station Master accordingly, under exchange of private number.

(10) Station Master shall then issue a caution order to Loco Pilots of all trains to proceed cautiously, and pass the reception/departure signal at 'ON' position on green hand signal of the Gateman, if the Gate is broken, but is clear of any obstruction

(11) Gateman shall secure the Gate against road traffic by means of safety chains and padlocks and there after exhibit green hand signal, if the Gate is not obstructed.

(12) Station Master shall advise maintenance staff responsible for maintaining the Lifting Barriers to repair the same at the earliest.

(13) Normal working will be resumed only after maintenance staff rectifies the defective lifting barrier and issue reconnection / fit memo for the same.

(14) Any abnormal situation, for example broken Gate Warranting requirement to warn the road users, the first action Gateman should take is to put the road signals to danger position. In order to do so Gateman should turn Road Signal Switch to reverse position on Gate Operating Panel.

1.8 Obstruction on the Track near Level Crossing

If there is a rail fracture or obstruction on the track due to falling of a tree, fouling by road vehicle or derailment which is visible to the Gateman, the Gateman and Station Master will adopt the procedure given under item Para 1.7 above. If the obstruction fouls the Level Crossing Gate, Gateman must keep the Gates closed against road traffic till the track is cleared of the obstruction.

1.9 Putting Road Signals at ON in Emergency

Any abnormal situation, for example broken Gate Warranting requirement to warn the road user, the first action Gateman should do is to put the road signals to ON. In order to do this, he should turn the road signal control switch to reverse on CCIP.

1.10 Putting Gate Signals at ON in Emergency

This facility is given to Gateman in the case of Emergency. If Gateman sees any abnormal situation at LC gate for which train stopping is necessary, the Gateman shall turn the Emergency Rotary Switch provided in sealed box to reverse for the Gates in Station Sections and Gate Control Switch to normal for the Gates in the Block Sections to make Gate Signals to 'ON'. Now UP and DOWN Gate Signals of both IR & EDFC lines become Red. At same time this all occurrence shall be informed to concern Station Master(s) and S&T officials. After clearing abnormal situation at Gate, Gateman shall turn back the Emergency Rotary Switch to Normal position.

2. WORKING METHODOLOGY OF LC GATES OF IR FALLING IN PARALLEL ALIGNMENT WITH EDFC-2 AFTER BEING INTERLOCKED WITH AUTOMATIC BLOCK SIGNALLING SECTION OF IR AND EDFC-2.

Operation of Level Crossing gates when EDFC and IR tracks are on the Parallel Alignment and Automatic Block System of Working is in force on EDFC as well as IR and the Level Crossing Gate is Interlocked with EDFC and IR System and Normal position is 'OPEN' to road traffic.

2.1 Level Crossing Equipment

Single set of electrically operated common Lifting Barriers along shall be provided outside of IR and EDFC tracks. In addition to Lifting Barriers one additional Sliding Boom on each side of power operated lifting barrier will be provided and each Sliding Boom will be parallel to the existing power operated Lifting Barrier and will be installed such that the complete body of the boom is laying away from the road. The Sliding Booms installed are meant to be used in the case of emergency when the power operated lifting barrier are damaged or closed indication is not found due to any reason. Alternative arrangement of safety chain with Padlock also available to protect IR & EDFC tracks incase of emergency, when power operated lifting barrier and Sliding Booms are damaged/not functioning.

2.1.1 Control Cum Indication Panel (CCIP)

It is provided with following Controls/Indications (PS Signalling Works Clause 2.2.6(1)(k).

(1) IR SECTION

c) UP and DOWN Train Approach Warning indications separately provided for the respective track **(4kms).**

d) LC gate approach locked indications separately for UP & DOWN lines (**2.5 kms).**

e) A common push button to acknowledge approach warnings for UP & DOWN lines.

f) ON & OFF aspects indications of UP & DOWN Gate Signals.

(2) EDFC SECTION

(a) UP and DOWN Train Approach Warning indications separately provided on the respective track **(6 Km).**

(b) LC gate approach locked indications separately for UP & DOWN lines (from **4 Km).**

(c) Push buttons to acknowledge approach warnings for UP & DOWN lines.

(d) OFF & ON aspect indications (including A & AG markers) of UP & DOWN Gate Signals.

(e) Gate Replacement Track Indications for UP & DOWN lines.

(4) COMMON CONTROL AND INDICATIONS

(e) OFF & ON indications of Road Signals.

(f) Two position Rotary Switch to raise the Gate Signals to ON in emergency is provided with sealing arrangement inside a wooden box with front cover of glass & mounted suitably on the wall of Gate Lodge (for Gates in Station Sections).

(g) Two position Gate Control Switch to raise the Gate Signals in case of Emergency and also to acknowledge that the Gate is free from any obstruction (for Gates in Automatic Block Sections)

(h) Two position Road Signal Switch to raise the Road Signals in case of Emergency and also before the closing the Sliding Boom.

(i) Sliding Boom Close Indication.

2.1.2 Emergency Key for Manual Operation of Lifting Barriers

Emergency Key for Manual Operation of Lifting Barriers is provided in the gate lodge with the following arrangement: (PS Signalling Works Clause 2.2.6(1)(m))

(1) Crank handle with key for manual operation of gate in case of power failure is kept in a sealed glazed box in gate lodge.

2.1.3 Electrical Key Locking Equipment (KLR) of Sliding Boom

Electrical Key Locking Equipment (KLR) is provided in the gate lodge with the following arrangement:

(3) Electrical Key Locking Equipment to lock key after closing the Sliding Boom.

(4) Push Button to release the key for opening the Sliding Boom.

2.1.4 Gate Operating Panel — (Outdoor)

A Gate Operating Panel - Outdoor is provided at a suitable location at the LC gate that provides clear visibility for the Gateman of approaching road traffic. The Gate Operating Panel-Outdoor is provided with following indications and buttons.

(4) Two indications, one indication for the 'Open' and one for 'Close' condition of the Barriers.

(5) Two Push buttons are provided, one for the Closing and one for Opening the Barriers.

(6) Indication for availability of power for motor operation of the Barriers.

2.1.5 Road Traffic Signals

Road traffic signals are provided on tubular posts on each side of the LC gate for road users at a suitable location so as to be visible clearly to the approaching road vehicles. The road traffic signals shall show the following aspects: (PS Signalling Works Clause 2.2.6(1)(h) & 2.2.6(2)(i))

(5) Steady Red aspect to indicate the "CLOSE" when gate closed for Road users.

(6) Steady Yellow aspect to indicate the "OPEN" condition of the Road Barriers.

(7) Flashing Red Aspect to indicate the Gate Barriers are in the process of being closed.

(8) Steady Yellow Aspect to indicate the Gate Barriers are in the process of being opened.

2.1.6 In case of Emergency Gateman will put the road traffic signal to "RED" aspect by turning road signal switch to reverse position provided on CCIP. (PS Signalling Works Clause 2.2.6(1)(l))

2.1.7 Hooters

Hooters, mounted on Road Signal posts, working in conjunction with the road signals, are provided at the LC Gate to warn the road users of the imminent closing/opening of the Barriers. The hooters shall cease sound when the Barriers are fully closed or fully opened.

2.1.8 Electrically Operated Boom Barriers

The Boom Barriers to be used will comprise of ELB boom barrier mechanism with Barrier Pedestal & Boom lock posts. The Barriers are fitted with a Stop Board, Boom Light box and MS counterweights. When closed, each boom barrier will rest on a Boom Barrier post and be locked in closed position by a boom solenoid locking system/motorized Locking system. (PS Signalling Works Clause 2.2.6(2)(c))

2.1.9 Sliding Boom Barriers

The Gate is provided with one additional Sliding Boom on each side of power operated lifting barrier. Each Sliding Boom will he parallel to the existing power operated Lifting Barrier of its side and would

normally so positioned that the complete body of the boom is laying away from the road and padlocked i.e. no part of the Sliding Boom shall normally project on to the road leading to the L.C. gate. The Sliding Booms installed are meant to be used in case of emergency when the power operated Lifting Barriers are damaged or close indication not found due to any reason. These are normally locked on its post, with padlock. The Keys inside the locks provided on Boom stands. (PS Signalling Works Clause 2.2.6(1)(o)).

2.1.10 Safety Chains

Safety Chains are provided on each side of road to block the road traffic in case of failure/damage of ELB and Sliding Boom Barriers. One End of Safely chain shall be permanently welded to the post and other end shall be with locking arrangement with post on other side of road.

2.1.11 Telephone

(3) Selective Calling telephone is provided at LC gate to communicate with SM/EDFC. (PS Signalling Works Clause 2.2 6(1)(n))

(4) Existing Magneto telephone will be shifted from Existing Gate Lodge to New Gate lodge to communicate with SM/IR.

2.2 Method of Closing and Opening the Electrically Operated Gate

(3) Whenever any train is to be dispatched towards the Level Crossing the SM/EDFC or SM/IR station shall advice the Gateman of Level Crossing No. XX about the train number, description direction and likely time of passage of the train.

(4) As soon as the train reaches a predetermined point of **6 kms** on EDFC and **4 kms** on the IR track in rear of the gate, a buzzer will start sounding in the Gate lodge intimating the gate man of the approach of a train. The Gateman shall acknowledge the concerned buzzer and the Gateman shall thereafter get ready to close the Gate in time against the road traffic for the passage of the train. If the Gate is already in closed position, the buzzer shall not sound but an indication shall be displayed in the CCIP. (PS Signalling Works Clause 2.2.6(1)(i).

(5) The Gateman shall then press the Gate closing push button on the Gate Operating Panel - Outdoor to close the gate for road traffic. The electrical lifting barrier booms will start lowering and as soon as the lowering of booms is started, the road signals shall start displaying a Steady Red light towards the road users and Hooter will also start sounding. After lowering of the booms fully, the Barriers get locked automatically by electrical lock provided on the boom locking post. Barriers Close indication will be lit and hooters will stop sounding.

(7) After fully lowering of booms, the Gateman has to turn the Gate Control Switch to Reverse position by ensuring that the Gate is clear of any road vehicles.

(8) As soon as the booms are fully closed and the Gate Control Switch is turned, the Gate Signals shall assume “OFF’ aspect.

(9) When the train is on Approach Locking Track i.e. **4 Kms** on DFCC lines and **2.5 Kms** on IR lines, the Gate Lock indicate will appear on the indication panel and the Booms cannot be opened thereafter till the passage of the train from the Level Crossing. (PS Signalling Works Clause 2.2.6(1)(j))

(10) After passage of the train and when both IR & EDFC approach tracks are clear, the Gateman shall then proceed to the Gate Operating Panel- Outdoor and operate "Open" push button. The Boom Barriers start going up and when the barriers are 2° from the

horizontal the road signals display flashing Yellow. When the Barriers are at 85° from vertical position Road Signals display Steady Yellow aspect.

Note:

c) When UP OR DOWN "Approach warning" light is lit on the CCIP, it is advised not to open a closed Gate.

d) In case of emergency it is possible to open the LC Gate even though the LC gate is approach locked. It may be opened after putting back the Gate Signals to danger and with a time delay of two minutes by turning Gate Control Switch.

e) If a second train occupies the Approach Warning track circuit before the first train clearing the LC Gate, no buzzer sounds but the Approach Warning track continues to show occupied even after the first train clearing the Gate until the last train clear the LC Gate **for both IR and DFC lines.**

f) After passage of a train if Gate is not opened before the second train occupying the approach track, the Gate gets locked electrically without the operation of Gate control button by Gateman (Gate will continue to remain electrically locked for all such situations) and Gate Signals will clear automatically as per interlocking conditions for **automatic section only.**

2.3 Method of Operation of Gate by using Sliding Boom

The Gate is provided with one additional Sliding Boom on each side of power operated lifting barrier. Each Sliding Boom will be parallel to the existing power operated Lifting Barrier of its side and would normally so positioned that the complete body of the boom is laying away from the road and padlocked i.e. no part of the Sliding Boom shall normally project on to the road leading to the LC Gate. The Sliding Booms installed are meant to be used in case of emergency when the power operated Lifting Barriers are damaged or close indication not found due to any reason. These are normally locked on its post, with padlock. The Keys inside the locks provided on Boom stands. (PS Signalling Works Clause 2.2.6(1)(o))

2.3.1 Mode of operation for closing the gate by the Sliding Boom

The Gateman, after getting specific instruction from SM on duty of IR / EDFC controlling station, will restrict the road traffic by closing the Sliding Boom. During this process he will put back road signal to danger by turning the Gate signal switch close on Gate Operating Panel — Outdoor then he will slide the Sliding Boom on EDFC track side by pulling the handle to close position up to stand provided for the purpose. He will insert the chained key in the boom stand lock and lock it; a key marked 'X' will be released, thereafter he will go to the IR track side and by pulling the handle to close position of the Sliding Boom up to its boom stand, will insert the chained key marked 'Y' in the boom stand lock and lock it. Also insert the 'X' key in the lock marked 'X' and turn clockwise in boom lock stand. After locking both keys, a 3rd key'Z' will be released. The Gateman will take the key, apply it to the KLR fitted in the Gate lodge and turn it. Now Gateman turn the Gate Control Switch to reverse position after ensuring that there is no vehicle in between the Sliding Booms.

Sliding Boom Barrier closed indication will appear on CCIP and Gate Signals will come to caution aspect automatically.

2.3.2 Mode of operation for opening the Gate by the Sliding Boom

For opening of the Sliding Boom after passage of the train/trains, gateman will get specific permission from SM on duty of both IR & EDFC stations to open the Sliding Boom to clear the road traffic. After getting permission from both SMs, Gateman will take out 'Z' key from KLR apply it in

Sliding Boom of 'Z' lock and adopt procedure in reverse order of closing the Sliding Boom to clear the road traffic.

2.4 Method of Operation of Gate by using Safety Chain

2.4.1 Mode of Operation for closing the gate by use of the Safety Chain

If gateman is not able to pull the sliding boom due to any failure/damage, safety chain can be used to block the road traffic.

During this process gateman will first put the road signal to RED aspect by turning the road signal switch then he will use the safety chain by pulling the Chain to other end of the road and pad lock the safety chain with the post provided for this purpose. There after he will go IR track side and use the safety chain across the road up to the post and pad lock with the post. He will keep both the pad lock keys in his custody. In this case no signal will come to off and working of trains shall be governed as DFCR GR 216.

2.4.2 Mode of Operation for opening the gate by use of the Safety Chain

For opening of the Safety Chain after passage of the train/trains, gateman will get specific permission from SM on duty of both IR & EDFC stations to open the Safety Chain to clear the road traffic. Thereafter he will turn the gate signal switch to normal to throw the gate signal to yellow.

2.5 Failure of Telephonic Communication

When telephonic Communication provided at LC gate for communication with IR stations or EDFC station fails or SM does not get any response from the Gateman despite 2 or 3 attempts following procedure should be adopted.

(7) The Station Master at the dispatching end shall issue a caution order to the Loco Pilot before dispatching a train in the Automatic block section from his end.

(8) Station Master shall advise the Loco Pilot to whistle continuously and proceed cautiously while approaching the gate.

(9) In case the gate signal is 'ON' Loco Pilot should stop short of the gate signal and follow the procedure laid down under DFCR GR 216.

(10) In case of an approaching train, the Station Master shall advise the SM at the other end, under exchange of private number that the telephone at the gate has failed.

(11) Station Master should also advise S&T staff responsible for maintenance of the telephone to rectify the same at the earliest.

(12) Normal working will be resumed only after S&T staffs rectify the telephone and issue reconnection/fit memo for the same

2.6 Failure of Electrical Operation of Lifting Barrier

(6) When the Gate cannot be close/open due to failure of power operation of Lifting Barriers the Gateman will immediately inform the SM IR & DFCC on duty, under exchange of private number,

(7) Station Master should advise S&T staff responsible for maintenance of the Lifting Barriers to rectify the same at the earliest.

(8) Gateman will record the date and time with reason for taking out the crank handle from sealed box to close/open the gate as the case may be.

(9) After manually closing/opening of the Gate, the Gateman shall keep the crank handle key back in its position and inform the SM on Duty and S&T staff to seal the Crank Handle box.

(10) Normal working will be resumed only after S&T staffs rectify the Lifting Barriers and issue fit memo for the same.

2.7 Obstruction at the Gate

(15) If the Gate is broken by aroad vehicle which is fouling the track, or if Lifting Barriers or any other part of the Gate foul the track, or if there is any other obstruction at the Gate, the Gateman shall immediately put back gate signal to danger as described in para 2.10 and then fix Red banner flag by day and flashing Red lamp by night on posts provided at both ends of the Gate for this purpose.

(16) Immediately after this, the Gateman shall advise the SM IR/DFCC on duty regarding the defects/obstructions at the gate, under exchange of private number.

(17) SM on duty shall be advised to put the reception / departure signals back to 'ON' position it taken "OFF" for a train.

(18) If there is no response from the SM after two or three attempts, he shall first protect the Gate and then inform on phone.

(19) Gateman shall then rush with detonators and Red flag by day and flashing Red hand signal lamp by night in the direction of the Approaching train and protect the Gate as stipulated.

(20) There after he shall protect the Gate from the other direction.

(21) Gateman shall note down the particulars of the road vehicle, name of the driver, owner and relay these details to the Station Master of IR/DFCC not to start the train unless they have been assured by the Gateman that the road vehicle or the Lifting Barriers are not fouling the track.

(22) The Station Master shall also inform the Station Master at the dispatching end, under exchange of private number, asking him not to dispatch any train in the block section from his end, until the track has been cleared of all obstruction.

(23) After the track has been cleared of all obstructions the Gateman shall inform the Station Master accordingly, under exchange of private number.

(24) Station Master shall then issue a caution order to Loco Pilots of all trains to proceed cautiously, and pass the reception/departure signal at 'ON' position on green hand signal of the Gateman, if the Gate is broken, but is clear of any obstruction

(25) Gateman shall secure the Gate against road traffic by means of safety chains and padlocks and there after exhibit green hand signal, if the Gate is not obstructed.

(26) Station Master shall advise maintenance staff responsible for maintaining the Lifting Barriers to repair the same at the earliest.

(27) Normal working will be resumed only after maintenance staff rectifies the defective lifting barrier and issue reconnection / fit memo for the same.

(28) Any abnormal situation, for example broken Gate Warranting requirement to warn the road users, the first action Gateman should take is to put the road signals to danger position. In order to do so Gateman should turn Road Signal Switch to reverse position on Gate Operating Panel.

2.8 Obstruction on the Track near Level Crossing

If there is a rail fracture or obstruction on the track due to falling of a tree, fouling by road vehicle or derailment which is visible to the Gateman, the Gateman and Station Master will adopt the procedure given under item Para 2.7 above.If the obstruction fouls the Level Crossing Gate. Gateman must keep the Gates closed against road traffic till the track is cleared of the obstruction.

2.9 Putting Road Signals at ON in Emergency

Any abnormal situation, for example broken Gate Warranting requirement to warn the road user, the first action Gateman should do is to put the road signals to ON. In order to do this, he should turn the road signal control switch to reverse on CCIP.

2.10 Putting Gate Signals at ON in Emergency

This facility is given to Gateman in the case of Emergency. If Gateman sees any abnormal situation at LC gate for which train stopping is necessary, the Gateman shall turn the Emergency Rotary Switch provided in sealed box to reverse for the Gates in Station Sections and Gate Control Switch to normal for the Gates in the Block Sections to make Gate Signals to 'ON'. Now UP and DOWN Gate Signals of both IR & EDFC lines become Red. At same time this all occurrence shall be informed to concern Station Master(s) and S&T officials. After clearing abnormal situation at Gate, Gateman shall turn back the Emergency Rotary Switch to Normal position.

(End of Appendix 1)

Appendix 2

Uninterruptible Power Supply System - Technical Specifications

1. General

(1) The UPS and battery backup equipment shall conform to latest versions of following international standards covering Safety, construction, electromagnetic interference and operation. In case of any conflict, more stringent requirement shall apply

RFI Suppression	EN 55022A or VDE 0878
Boost cum float charger	IEC 60146, DIN-41772
General & Safety requirement	IEC 62040-1-1
EMC requirements	EN 50091-2, EN 50091-3
Protection class	IEC- 60950
Compliance to Quality Standards	ISO 9001-2008 & ISO 14001
Automatic Transfer Switches	IEC 60947-6-1, UL 1008 Listed
VRLA Batteries	IRS: S 93-96, IEEE485 Sizing
Protection against Lightning	IEC 62305
Railway applications – Surge arresters and low-voltage limiters for specific	IEC 61992
Transient Voltage Surge Suppressors	IEEE C62.41 Sizing, UL1449-3 Listed
Overall UPS System	IEC 62040-3, IEC60146

(2) The design shall take into consideration the voltage drop between the power supply source and the Signal & Telecommunication systems load (as the case may be), individually at each location (Auto location/ station etc.).

(3) Provision of suitable earth leakage detection and alarms shall be made individually at each location (Auto Location/station etc.).

(4) Conceptual design of the UPS and the battery backup for Signalling and Telecommunication Systems is as per attached Single Line Diagrams. (Annexure I & II of Appendix 2). The contractor shall submit detailed design separately for Stations, Auto Locations and OCC for review by the Engineer.

(5) OCC UPS System shall have Load Bus Synchronization (LBS) Panel to ensure same parameters like frequency and voltage etc. in both buses. Supply to single source critical load shall be through free standing independent external static switch which will be connected from both Buses for its input sources as shown in Single Line Diagram (Annexure II of Appendix 2). External Static Switch shall be as per specifications mentioned in Para no -12 of this document.

2. System Operation

The UPS system shall be designed to operate in the following modes:

(1) **Normal**

The incoming power supply reaching the UPS Modules through an Input Isolation Transformer shall be rectified into regulated DC voltage for charging the battery and powering the inverter to supply the loads.

(2) **Emergency**

Upon failure or fluctuation of the incoming supply beyond acceptable limits an Automatic Transfer Switch shall detect and transfer/switch to the other incoming source so that supply to the UPSs and Stabilizer is maintained. In case of absence / failure or fluctuation of both the Input Supply sources, the battery banks of the UPS shall, without interruption, supply DC power to the UPS inverters to supply the loads. When incoming mains supply is restored or returned to the specified limits, the rectifier shall resume normal operation automatically without disturbance to the loads. During this transition of the DC Supply to Inverter, from Rectifier to Battery and vice versa, there should not be any switching delay since the Battery bank will be directly connected to the Rectifier-Inverter DC Bus and Floating on the DC Bus. Inverter shall not be connected to its input DC Bus through any switching devices or reverse blocking diodes

(3) Automatic Transfer Switch shall be a self-powered equipment having complete overlapping neutral, in-phase monitor and operated by a single solenoid, with microprocessor based controller suitable for 230 V / 415V, 50 Hz supply. The ATS shall be conforming to UL-1008 and shall be 3rd party tested with a circuit breaker back up for withstand and close on rating (WCR). The ATS shall be tested for AC-33iA/AC-33A utilization category and shall have inbuilt voltage, frequency and single phasing protection.

(4) **Parallel Redundant Operation**

Normally, both the 100% rated Inverters will be supplying to the Load sharing it on 50:50 basis. In the event of internal failure/tripping of any one Inverter, there shall be no transfer of load, rather the faulty Inverter shall isolate itself giving adequate alarm indication and the healthy Inverter, which was already sharing 50% of the load, shall continue to work unaffected, taking-up the full 100% load.

(5) **Automatic in-built Static Bypass**

In the event of the inverter output fault or fault leading to tripping of both the 100% rated Inverters, the in-built Static Switches of Inverter Output and Static Bypass Line shall automatically transfer the loads to the stabilized bypass without any power discontinuity / interruption provided the frequency of the mains input source is within the acceptable band (it is assumed that the bypass source being stabilized, its voltage will always be within the tolerance of the loads). When the inverter output recovers to a suitable level, the switch shall automatically restore the load from the stabilized bypass source to the inverter output.

(6) **In-Built Manual Bypass**

Each UPS Module will contain 100% rated manual bypass path to allow a no-interruption (i.e., make-before-break) transfer of the loads to the stabilized bypass source for safely carrying out simultaneous online checks/maintenance of the two

UPS Modules. Adequate interlock shall be provided to prevent operation of the manual bypass switch when both the Inverters are healthy and supplying to the loads.

(7) **External Super-Bypass**

A manual external Super-bypass system shall be provided to allow the UPS modules to be completely isolated for maintenance/repair requiring de-energization of UPS Output terminals or physical relocation/movement of UPS's. Warning labels and adequate interlocks shall be provided to prevent the bypass supply being connected to UPS output terminals while the UPS is healthy and running.

3. Equipment Design of UPS

(1) The audible noise level at 1.5 m radii of the panel, over a load range 10% to 100% full load shall not exceed 56 dBA for UPS Systems rated 30 KVA or below, 65 dB A for UPS Systems between 30-60 KVA and 70dBA for UPS Systems rated between 60-120 KVA.

(2) The UPS system provided by the Contractor shall be sized to power its full connected load of the Signal & Telecommunication systems working in parallel redundant configuration with at least 20% spare capacity. The back-up shall be for a total period of four hours (2 hours for each UPS Module at full load).

(3) Each Parallel redundant UPS System shall include adequately rated Automatic Transfer Switch and Input Isolation Transformer, 2x100% rated Rectifier-cum-charger, 2x50% rated battery banks, 2x100% rated IGBT PWM inverters, 2x100% rated output isolation transformers, 1x100% rated Servo Controlled Voltage Stabilizer, 2x100% rated Static Bypass Lines (i.e. 4x100% rated Static Switches), 2x100% rated Manual Bypass lines Switches, 1x100% rated Super-Bypass Line and all associated control circuitry to make the system complete. Failure of any single component shall not cause failure of the total UPS.

(4) The UPS shall be self-contained floor mounted, bottom entry, metal-clad type with front access. UPS shall be supported on a base frame of at least 150mm height.

(5) Power supply for the Signal & Telecommunication systems shall have the UPS back-up. The UPS system shall be designed with 100% parallel redundancy with four hour battery backup (each UPS Module should have separate individual battery bank rated 50% i.e, to deliver backup to full load for 2 hours). The two separate 50% Battery Banks will normally work as independent battery banks connected to their respective UPS Modules and shall have provision of their interconnection / paralleling in order to achieve full 100% capacity (i.e. 4 hour backup) in case of simultaneous failures of any one Inverter and all the Input AC Supplies.

(6) The UPS shall be designed such that failure of or restoration of the 230V AC 1 phase / 415 V AC 3 phase input supply sources shall not have any change or effect and the UPS Inverters will continue to supply to the loads without interruption. Galvanic Isolations both at the Input as well as at the inverter Outputs shall ensure that at no point of time any part of the input supply is electrically connected to the UPS Output bus. Upon restoration of the Input Supply, the UPSs and Stabilizer shall be transferred to it only after a delay and verification that there are no spikes and that the voltage has stabilized.

(7) Two independent redundant 1-Phase / 3-phase primary power supply will be made available by 'Other Contractor' on the LT Panel provided by him in the OCC. The Contractor shall coordinate with the 'Other Contractor' and carry out all works required to draw the primary power supply from the LT Panel to the UPS.

(8) **Ripple content in intermediate DC**

- With Battery : < 1%
- Without Battery : < 2%

4. Parameters Applicable to UPS

(1) **System Input Characteristics:**

The primary power for the rectifier shall be provided from the switchboards with the following characteristics :

Voltage	415 V, +10%, -20% (for 3-Phase Input Systems) 230 V, +10%, -20% (for 1-Phase Input Systems)
Frequency	50 Hz, +/- 1%
Power Factor	Not less than 0.8 lagging when the system is operating at full load and nominal voltage.

(2) **System Output Characteristics**

(a) UPS ratings shall be subject to approval by the Engineer based on Load sizing calculations submitted by contractor during detailed engineering.

(b) **Output Voltage Requirements**

Voltage	400V, 3-Phase, four wires (for 3-Phase UPS Systems). 230V, 1-phase, two wires (for 1-Phase UPS Systems).
Frequency	50 Hz nominal, +/-1% regulation (free running)
Voltage regulation	Static: Better than +/- 1 % Dynamic: Better than +/- 5% (0-100-0% Load Step)
Distortion factor	For linear load: < +/- 1%, For 100% non linear load having Crest Factor of 3:1):< +/- 5%.
Crest factor (sustainable by UPS without de-rating)	3:1

(c) **Output Voltage Stability**

The steady state output voltage shall not deviate by more than +/- 1% from no-load to full-load. The allowable transient output voltage variation is +/-5% and the system output voltage shall return to +/- 1% within 20ms.

(d) **Output Frequency Regulation, Stability and Slew Rate**

The UPS shall be capable of providing the nominal output frequency within 50 Hz +/- 1% when the UPS inverter is not synchronized to the incoming mains. When the UPS Inverters are synchronized to Main Frequency, the

frequency variation range will be limited to the synchronizing window of 50 Hz +/- 2 Hz. UPS should have facility to set the synchronizing window between +/-1 Hz, +/- 2 Hz, +/-3Hz. The rate of tracking with Mains Frequency (Slew Rate) shall be 1 Hz per sec.

(3) **System Overload**

Overload capacity(better than) : 150% >60 seconds

: 125% >10 minutes

: 110% >60 minutes

The short circuit current limit shall be set at 155% of the rated output current.

(4) **Output Voltage Harmonic content**

The total harmonic distortion (THD) of Inverter Output Voltage waveform as generated by the UPS Modules shall be less than 1% for Linear Loads and less than 5% for 100% non-Linear Loads having crest factor of 3:1. Harmonic Distortion for any single harmonic shall be maximum 3%.

(5) **Efficiency (AC-AC)**

The UPS System including the Isolation Transformers shall have an AC-AC efficiency of 85% minimum at full load. The AC-DC Efficiency of each Rectifier-Cum-Charger / Inverter at full Load and while catering full Charging current to Battery, shall be 98%.

(6) **Electromagnetic Interference**

Filters shall form an integral part of the UPS to prevent any form of electrical noise or radio frequency interference being generated that may affect the critical load.

(7) **Current Limiting**

The rectifier/charger shall have input current limiting at 115% so as to disallow any current other than the maximum requirement due to Load Current through Inverter/s and Battery Charging Currents.

(8) **Input Power Walk-In**

When the mains are restored following an outage, the power and current drawn by UPS modules shall be initially minimum and slowly shall rise to required level in 10-15 sec. to drive the critical load and the additional pre-set power to recharge the batteries as described above.

5. Battery Banks & Sizing

(1) The battery bank shall consist of two nos. of 50% rated banks of high quality heavy duty maintenance free valve regulated lead-acid (VRLA) 2V Cells having 20 Year designed Float Life, each bank connected to its individual UPS Module, capable of maintaining supply to its inverter at full load for not less than 2 Hours in the event of failure of mains supply or rectifier.

(2) The two Battery Banks will be normally, separately connected with their respective UPS Modules and give 4 hour backup during normal operation of the two Inverters in Parallel Redundant configuration where each Inverter is loaded 50%. Further, there will be provision of Interconnection/Paralleling between the two Battery

Banks to achieve 100% rating (4 hour backup) in the event of Input Supply failure during single UPS Module operation (other Module Inverter faulty or not in circuit).

(3) It shall be possible to Isolate individual battery bank and work on it and still have 50% (2 Hours) Backup Power availability from the UPS System to the Loads.

(4) The battery racks shall have anti acid painting and adequate insulations. The battery racks shall be properly insulated and earthed.

(5) The battery shall be adequately designed to reduce all possible voltage drop between cells and battery plates and battery plates to conductors bars.

(6) The life of the battery bank shall not be less than 7 years. The Contractor shall submit documents to verify the life of batteries.

(7) Separate, externally wall-mounted independent, adequately rated battery circuit breakers for protection shall be provided between the battery bank and the individual UPS modules thereby, isolating the battery bank from the rest of system. The Battery Circuit Breakers (2 Nos. in each set of 2x100% rated UPS) shall have thermal, magnetic as well as under voltage remote tripping mechanism so that they can be remotely tripped from the UPS front panel.

(8) The battery shall be sized for float voltage of 2.25 Volts per Cell and nominal voltage of 2 Volts per cell suitable for the satisfactory operation of the system and total autonomy of 4 hours. The Contractor shall submit detailed battery capacity calculations to the Engineer for review and approval as per the following minimum requirements:-

(a) Full KW rating of Inverter Output at 0.8 lagging P.F.

(b) Inverter Efficiency at 50% Load (maximum value to be considered for Battery Sizing shall not exceed 90% for 6 KVA, 93% for 30 KVA , 93.5% for 60 KVA and 94% for 120 KVA UPS's)

(c) Minimum End Cell voltage of 1.75 VPC

(9) Four no. of 2V Cells as per manufacturer and a Spare Cell Charger for charging up to 6 cells at 10% of Battery AH Capacity shall be supplied as Spares with the main supply.

6. Rectifier-cum-Charger & Sizing

(1) The power rectifiers shall be 1-Phase / 3 Phase, Full-wave, Fully-controlled, SCR Bridge Type/IGBT. A separate adjustable DC current limit circuit shall be provided for battery charging current. Subsequent to a discharge cycle when battery is connected to rectifier, the battery current shall be monitored, controlled and limited to set value automatically irrespective of value of inverter input current.

(2) Rectifier shall be designed to ensure that the total harmonic distortion in the input current to rectifiers as seen by the supply source Bus, is in line with the IEEE std. 519-1992 recommendations.

(3) The Rectifiers shall be sized based on the maximum inverter load and the nominal rated capacity of the battery. The DC load imposed by inverters shall be considered under the worst case where only one rectifier is feeding both inverters.

(4) The rectifiers shall be designed to completely charge their individual battery to 90% capacity within maximum 10 hours after complete discharge. Facilities shall

be provided to initiate battery boost charge operation by manual and automatic means as and when the Battery may require.

(5) The DC regulator shall sense the battery charging current and shall adjust the DC bus voltage to ensure constant current charging.

(6) Rectifier-cum-Charger should have temperature compensated dynamic Charging wherein, sensing higher ambient around the battery banks, the charging voltage should get automatically regulated at the rate of minus 2 - 3 milli-volt per Deg. C above the desired 27 Degree C. For this, vendor should supply temperature sensors to be fixed at the Battery Bank.

(7) UPS System should have Online Battery Testing feature from UPS front Panel.

(8) In line with DIN 41772 I-U Characteristics the Rectifier-Cum-Charger should automatically shift from Float to Boost Mode and vice-versa based on current demand sensing and have an over-riding Boost charge timer settable in 1-15 Hour range.

(9) Each Rectifier should have adequate rating to simultaneously cater full Battery Charging current and Inverter Current at full load considering that One Rectifier may have to cater charging current to both the 50% rated Battery Banks plus Inverter on full Load. The contractor shall submit detailed rectifier sizing calculations for review of the Engineer as per the following minimum conditions :-

(a) Total Rectifier Current = Inverter Input DC Current at full load + 2x10% of Battery AH Duty.

(b) Total Rectifier Power Rating (in W) = Rectifier Float level (at 2.25VPC) x Total rectifier current

7. Static Bypass Transfer Switch

(1) A static bypass transfer switch Module shall be provided as an integral part of the UPS. This will consist of two sets of 100% rated Static Switches – one for Inverter Output and the other for Static Bypass Line. The control unit shall contain an automatic transfer circuit that senses the status of the inverter logic signals and alarm conditions to provide an uninterrupted transfer of the load to the stabilized bypass source without exceeding the transient limits specified herein when a malfunction occurs in both the UPS Inverters or an external overload condition occurs.

(2) The static bypass transfer switch shall be a fully Solid State static switch having anti-parallel SCR's that has a maximum transfer time of less than 4 millisecond in Synchronised condition and less than 20 millisecond in Unsynchronised condition. The static switch shall be capable of supplying 125% rated current for 10 minutes, 150% for 60 seconds and 1000 % for one cycle.

(3) A transfer of load to the bypass supply shall take place in any of the following abnormal conditions:

(a) Inverter overload capability exceeded.

(b) Inverter output voltage exceeds the overvoltage trip level of 110% or under voltage trip level of 90%.

(c) D.C. over voltage.

(d) D.C. under voltage.

(e) UPS fault and

(f) UPS over temperature.

(4) Whenever the load is on the static bypass line, the control panel shall provide an indication of this status. The audible alarm shall sound appropriately. If the transfer was due to a momentary overload and was automatically restored to the UPS module after the overload was removed, the alarm and indicator shall automatically reset.

(5) The Voltage stability of the Stabilized Bypass source (Servo Controlled Voltage Stabilizer) providing supply to the Static Bypass, Manual Bypass, and Super-Bypass lines should not exceed 230V / 415 Vac +/- 2% in steady state conditions.

8. Enclosures

Following requirements for enclosures shall be met:

(1) Minimum degree of protection as per EN 60529:

IP31: for Stations & OCC

IP42:for Auto Location Huts.

(2) Material and construction: Welded mild steel. Assemble to prevent distortion when the complete enclosure is lifted or transported.

(3) Finish as provided by OEM.

(4) Lockable access doors.

(5) Cable entry with removable gland plates: For bottom entry cables.

(6) Forced ventilation fans: Required.

(7) Internal and External interlocking, padlocking, earthing, insulation, screening of enclosures.

(8) Protection against natural corrosion and galvanic corrosion of dissimilar metals.

9. UPS Monitor, Control and Information System

(1) The UPS system shall be equipped with a status panel to provide monitoring and control of the complete system. Basically, the system shall be able to display the following Alarms and Alerts on the System Front Panel LCD Screen upon their occurrence. If more than one Alarm occurs, they will be displayed in the Screen in continuous cyclic order:

(a) Output overvoltage

(b) Output switch open

(c) Rectifier switch open

(d) Battery C.B. open

(e) Manual bypass closed

(f) Bypass: absent

(g) Bypass: overvoltage

(h) Bypass: under voltage

(i) Bypass: frequency error

(j) Bypass: phase rotation error

(k) Bypass: off

(l) Load on bypass

(m) Rectifier: off

(n) Rectifier: blocked

(o) Rectifier failure

(p) Inverter: off

(q) Inverter: blocked

(r) Inverter: over temperature

(s) Inverter: unsynchronized

(t) Inverter: overvoltage

(u) Inverter: under voltage

(v) Output: under voltage

(w) Battery: under test

(x) Battery: test failed

(y) Battery: on load

(z) Battery: end discharge

(aa) Battery: boost time expired

(bb) DC bus: fast overvoltage

(cc) DC bus: under voltage

(dd) Overload shutdown

(ee) Over temperature shutdown

(ff) Emergency stop

(gg) Overload

(hh) Battery earth fault

(ii) Inverter: failure

(jj) Inverter: parallel error

(kk) Over-temperature failure.

(1) **System Metering**

A single or multiple LCD Panel Metering shall be provided with the capability of monitoring of the following system parameters using a selector switch:

(a) Output voltage (line-line)

(b) Output voltage (line-neutral)

(c) Output current (line)

(d) Output real power (line)

(e) Bypass frequency

(f) Inverter frequency

(g) Bypass voltage (line-line)

(h) Battery voltage

(i) Battery current

(j) Output apparent power (line)

(k) Temperature (battery room) - optional

(l) % line load

(m) % battery charge.

(2) **System Controls**

The following minimum user controls shall be provided on Front panel of each UPS Module:

(a) Alarm reset push-button.

(b) Inverter ON/OFF or Transfer to Static Bypass membrane switch.

(c) Emergency shutdown button with protective cover.

(3) **System Mimic Diagram**

A system mimic diagram using light emitting diodes (LEDs) shall be provided on the equipment as part of the system status panel. The mimic shall depict a complete single line diagram of the UPS and the following functions shall be lit with LED indicators.

(a) A.C. input power on;

(b) UPS on battery;

(c) Inverter ON;

(d) Static Bypass ON and healthy;

(e) Load supplied from Inverter and

(f) Load supplied from Static Bypass UPS.

(4) **Potential Free Contacts**

Normally open and/or normally closed dry contacts shall be provided for the following minimal conditions :

(a) Low Battery (pre alarm)

(b) Load on Inverter

(c) Load on Bypass

(d) Load on Manual Bypass

(e) Bypass failure.

(5) **Local Monitoring of UPS**

RS485 / Modbus connection should be available from each UPS for local monitoring. The contractor shall submit detailed list of Alarms/Parameters to be locally monitored for review and approval by the engineer.

(6) **Comprehensive Remote Monitoring**

(a) UPS System (i.e. individual UPS Modules and ATS) should be connectible to the TCP/IP based LAN Network through 3 Nos. dedicated LAN Ports in each UPS room and 1 No. dedicated LAN Port in the OCC. The detailed status/alarms should be available in the OCC and other terminals as per details given in TMS Technical Specification. Further, all necessary Software shall be provided and installed so as to see comprehensive data from all the Stations, Interlocking structures, OCC etc.

(b) Further, the contractor shall submit comprehensive remote monitoring philosophy for approval of the Engineer.

10. Environment

The UPS shall be designed for smooth continuous operation in the environment where it is installed. Alternatively, suitable Environment control measures shall be provided to maintain the environment within the design parameters.

11. Surge Suppression

(1) Critical and expensive electronic equipment should be protected from transient over-voltages by Transient Voltage Surge Suppressor. TVSS shall be put at the Input of each UPS and Bypass Stabilizer

(2) **The TVSS shall meet following primary requirements.**

Surge Current Capacity	:	25kA for 6 KVA UPS System, 50kA for 30 KVA UPS System, 100kA for 60 KVA UPS System, 160kA for 120 KVA UPS
Fault Current Capability	:	> 12KA I/C
Connection Type	:	Parallel
Fusing	:	Individual Fusing of MOV's including N-G
Enclosure	:	NEMA Tested
Mounting	:	Wall Mounting or within Panel itself.

(3) **TVSS - Detailed Specifications**

(a) TVSS shall be provided at the Input of each UPS and bypass Stabilizer and electrically located at the respective outgoing feeders in the Input Transformer Cubicle. Further TVSS shall be provided at each Outgoing Feeder of the UPS Output AC Distribution Panel. The ratings of the TVSS will be subject to approval.

(b) The TVSS shall be constructed of Metal Oxide Varistor (MOV) technology and internal surge capacitors.

(c) The surge protective devices shall be sized as per IEEE Std C62.41-1991 and IEEE Std C62.45-1992.

(d) Surge protective devices used for three-phase, four-wire circuits shall be connected in all combinations of line-to-line, line-to-neutral, line-to-ground, and neutral-to-ground. (L-L, L-N, L-G, N-G). Devices used for single-phase, three-wire circuits shall be connected in all combinations of line-to-neutral and neutral-to-ground.(L-N, N-G).

(e) The TVSS shall have a UL 1listing and labelled 1449-3 suppressed voltage rating of 800V peak.

(f) The unit shall have a maximum continuous operating voltage (MCOV) rating of minimum 320VRMS.

(g) The Response time of TVSS shall be <= 0.5 nanoseconds.

(h) The TVSS shall provide up to 40dB for RFI & EMI noise attenuation.

(i) TVSS monitoring shall consist of indicator lamps and form C dry contacts.

(j) Monitoring of all modes, including N-E is required.

12. External Static Transfer Switch

(1) This intelligent static transfer switch shall ensure instantaneous transfer of load between the two power sources (Buses). A static bypass transfer switch Module shall be provided as free standing cabinet. This will consist of two sets of 100% rated Static Switches – one for Source -1 and the other for Source -2.

(2) The control unit shall contain an automatic transfer circuit that senses the status of both sources and alarm conditions to provide an uninterrupted transfer of the load without exceeding the transient limits specified herein. The smart control shall enable user to select the priority of source. Transfer time shall be adjustable with sensitivity control.

(3) The static bypass transfer switch shall be a fully Solid State static switch having anti-parallel SCR's that has a maximum transfer time of less than 4 millisecond in Synchronised condition and less than 20 Millisecond in Unsynchronised condition. The static switch shall be capable of supplying 110% rated current for 60 minutes, 150% for 60 seconds and 1,000 % for 10 M.Sc.

(4) The control panel shall Display status of incoming power source and the condition of static switch. Static Transfer Switch status shall be monitored through remote monitoring using RS 485 / MODBUS protocol. Minimum rating of 3 – phase switch shall be of 60 Amp.

13. System Expansion

The UPS and Battery Backup system shall be designed and equipped with all necessary hardware, software and capacity for future 20% additional load.

14. Testing and Inspection

The UPS Systems shall be offered for Factory Acceptance Tests as specified in GS/PS. During Inspection, following Tests, but not limited to, will be witnessed:-

(1) 8 Hour Heat Run Test of UPS Module at full load and normal temperature.

(2) Regulation Test.

(3) Test of Parallel Operation & current sharing of UPS Systems.

(4) Transfer and retransfer Checks.

(5) Synchronization test.

(6) Overload capability test.

(7) Short circuit capability test.

(8) UPS efficiency Tests.

(9) Tests for performance of operating parameters and controls.

(10) Tests for various Alarm levels.

(11) Battery Capacity/Backup Test (at Battery manufacturer's works).

(12) Review of test reports for SCVS, Input Isolation Transformer and ACDB and

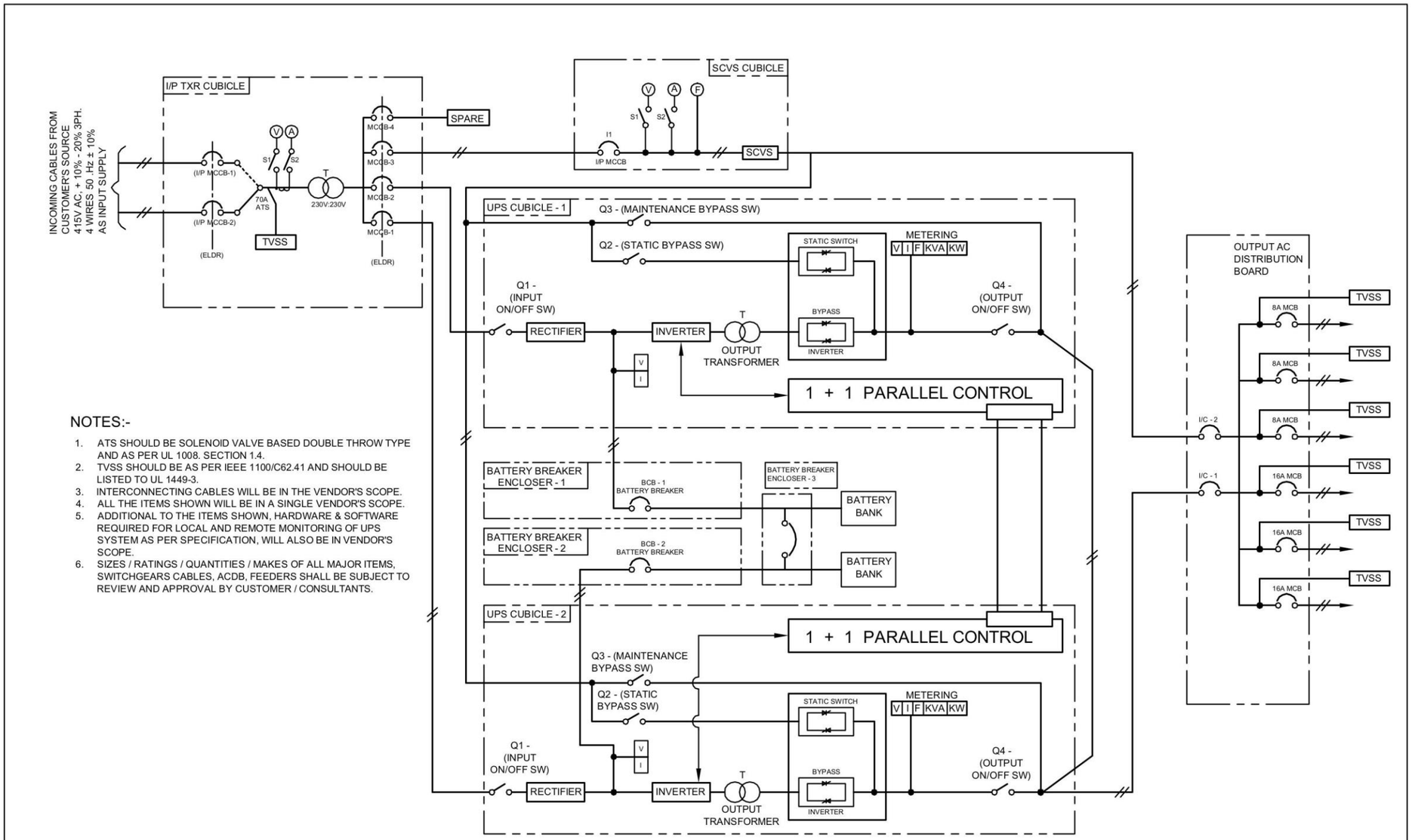
(13) Review of UL 1449-3 Listing Certificate for the TVSS selected.

(14) The battery discharge test shall be performed at a current corresponding to the inverter input current when the inverter is delivering its rated output full KW rating (i.e, KVA x 0.8 p.f.).

(15) The complete test schedule shall be as in standard formats of the vendor duly approved by the Engineer.

(16) Vendor shall submit and get approval of the required drawings before call for inspection is given.

Annexure I of Appendix 2

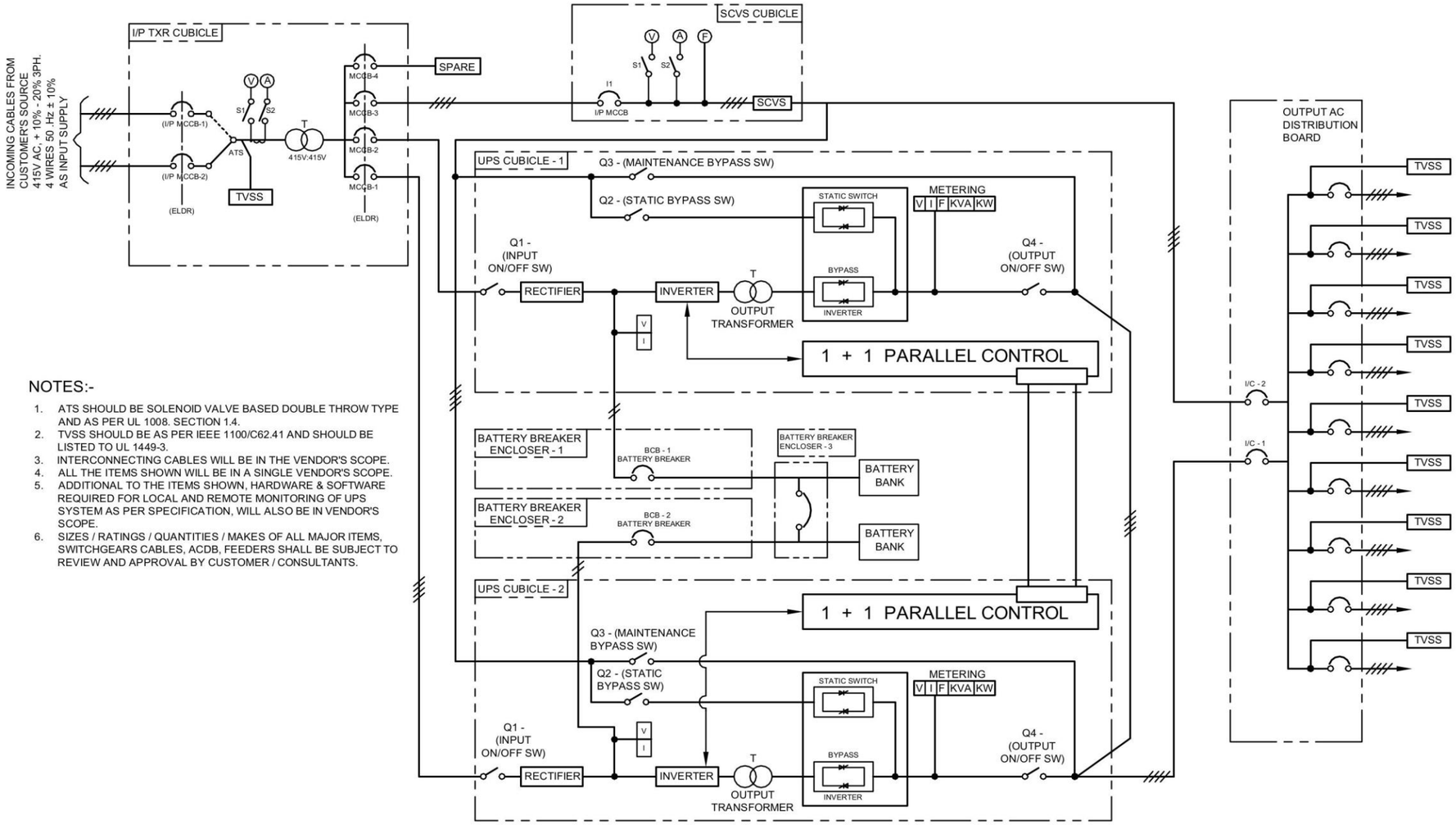


NOTES:-

1. ATS SHOULD BE SOLENOID VALVE BASED DOUBLE THROW TYPE AND AS PER UL 1008. SECTION 1.4.
2. TVSS SHOULD BE AS PER IEEE 1100/C62.41 AND SHOULD BE LISTED TO UL 1449-3.
3. INTERCONNECTING CABLES WILL BE IN THE VENDOR'S SCOPE.
4. ALL THE ITEMS SHOWN WILL BE IN A SINGLE VENDOR'S SCOPE.
5. ADDITIONAL TO THE ITEMS SHOWN, HARDWARE & SOFTWARE REQUIRED FOR LOCAL AND REMOTE MONITORING OF UPS SYSTEM AS PER SPECIFICATION, WILL ALSO BE IN VENDOR'S SCOPE.
6. SIZES / RATINGS / QUANTITIES / MAKES OF ALL MAJOR ITEMS, SWITCHGEARS CABLES, ACDB, FEEDERS SHALL BE SUBJECT TO REVIEW AND APPROVAL BY CUSTOMER / CONSULTANTS.

SINGLE LINE DIAGRAM FOR 1 - PHASE INPUT & 1 - PHASE OUTPUT UPS SYSTEM

Annexure II of Appendix 2



NOTES:-

1. ATS SHOULD BE SOLENOID VALVE BASED DOUBLE THROW TYPE AND AS PER UL 1008. SECTION 1.4.
2. TVSS SHOULD BE AS PER IEEE 1100/C62.41 AND SHOULD BE LISTED TO UL 1449-3.
3. INTERCONNECTING CABLES WILL BE IN THE VENDOR'S SCOPE.
4. ALL THE ITEMS SHOWN WILL BE IN A SINGLE VENDOR'S SCOPE.
5. ADDITIONAL TO THE ITEMS SHOWN, HARDWARE & SOFTWARE REQUIRED FOR LOCAL AND REMOTE MONITORING OF UPS SYSTEM AS PER SPECIFICATION, WILL ALSO BE IN VENDOR'S SCOPE.
6. SIZES / RATINGS / QUANTITIES / MAKES OF ALL MAJOR ITEMS, SWITCHGEARS CABLES, ACDB, FEEDERS SHALL BE SUBJECT TO REVIEW AND APPROVAL BY CUSTOMER / CONSULTANTS.

SINGLE LINE DIAGRAM FOR 3 - PHASE INPUT & 3 - PHASE OUTPUT UPS SYSTEM

Appendix 3

Deleted

Appendix 4

Drawings for Cable Laying

S. No.	Description	Drawing No.	Annexure No. of Appendix 4
1.	Joint Procedure Order for undertaking digging work in the vicinity of underground Signalling, Electrical and Telecommunication cables		Annexure - I
2.	DFCC Cable laying in Station yard	GGM/Signal/Indicative Drawing No.:1	Annexure– II(a)
3.	DFCC Cable laying in Block Section	GGM/Signal/Indicative Drawing No.:2	Annexure – II(b)
4.	Cable trench	SDO/CABLE LAYING/003	Annexure- III
5.	Laying of cables in rocky area	SDO/CABLE LAYING/008	Annexure- IV
6.	Track crossing	SDO/CABLE LAYING/009	Annexure- V
7.	Road crossing	SDO/CABLE LAYING/010	Annexure- VI
8.	Cable laying on culverts with low flood level	SDO/CABLE LAYING/011	Annexure- VII
9.	Cable laying on culverts with high flood level	SDO/CABLE LAYING/012	Annexure- VIII
10.	Cable laying on metallic bridges	SDO/CABLE LAYING/013	Annexure- IX
11.	Cable Trough for metallic bridges	SDO/CABLE LAYING/014	Annexure- X

Note: The sketches' given are indicative. The detailed drawings shall be proposed by the Contractor and approved by the Engineer.

Annexure-I of Appendix4

JPO No. 1/SG/2004

(Issued under CRB's letter No. 2004/Sig/G/7 dated 17.12.2004)

JOINT PROCEDURE ORDER FOR UNDERTAKING DIGGING WORK IN THE VICINITY OF UNDERGROUND SIGNALLING, ELECTRICAL AND 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 organization under open line or construction units under CAO/C are executing various signalling and telecommunication works requiring digging of earth for laying of cables or casting of foundations of the erection of signal posts etc. RailTel are 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 date 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 erection of OHE masts by Electrical Deptt. Generally, these works are executed by contractors employed by these organizations.

B. However, while carrying out these works in the vicinity of working signalling, 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 Deptts. Such Cable faults results in the failure of vital signalling and telecommunication circuits.

C. Henceforth, the following joint procedure shall be followed by Engineering, Electrical and S&T (and RailTel Organization, wherever such works are being done by them) Officers of the respective divisions and by the Construction Organization, while carrying out any digging work near to existing signalling& 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) & Electrical Deptts. shall provide a detailed cable route plan showing exact location of cable at an interval of 200m or wherever there is change in alignment so that the same is located easily by the engineering official/contractor. This cable route plans shall be made available to the DSE/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 a reasonable time in duplicate. DSE/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. 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.

(3) After getting the permission from S&T or Electrical Deptt. 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 cables 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 (Elect) shall be created chargeable to the execution of the work. However basic responsibility will be of the Department executing the work and the Contractor.

(4) The SE (P.Way) or SE (Works) shall pass on the information to the concerned SE (Sig) or SE (Tele) or SE (Elect) 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), which in turn shall pass on the information to the Test Room/Network Operation Centre of RailTel/TPC/Electrical Control.

(5) On receiving the above information, SE (Sig) or SE (Tele) or SE (Elect) 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 contract telephone number, the nature of the work shall be notified in the Engineering Control as soon as the concerned Engg. official issued the letter authorizing commencement of work to the contractor. Test Room be given a copy and Test Room shall collect any further details from the Engineering Control and shall pass it on to S&T/RailTel& Elect. officials regularly.

(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 Operations Centre of RailTel/TPE/Elect. Control.

(8) Where the nature of the work taken 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(Elect.) 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). The cable shall be reburied soon after completion of excavation with proper care including placement of the brick over the cable by the concerned S&T Supervisors or Electrical Supervisors. However, the work will be charged to the concerned engineering work.

(11) In all the sections where major project are to be taken up/going on RailTel/S&T Deptt. shall deploy their official to take preventive/corrective action at site of work.

(12) No new OFC/Quad cable shall be laid close to existing track. It shall be laid close to Railway boundary as per extant instructions i.e. 1.0 m from the Railway boundary to the extent possible to avoid any interference with 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. Henceforth, wherever cable laying is planned and before undertaking the laying work, the cable route plan of the same shall be got approved from the concerned Sr. DEN or Dy. CE/ Constn. to avoid possible damages in future. Such approvals shall be granted within 7 days of submission of the requests.

(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) Any damage caused to OFC/Quad cable or Electrical cable during execution of the work, necessary debit shall be raised on Engineering Department who shall bear the cost of the corrective action.

(15) All types of 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.

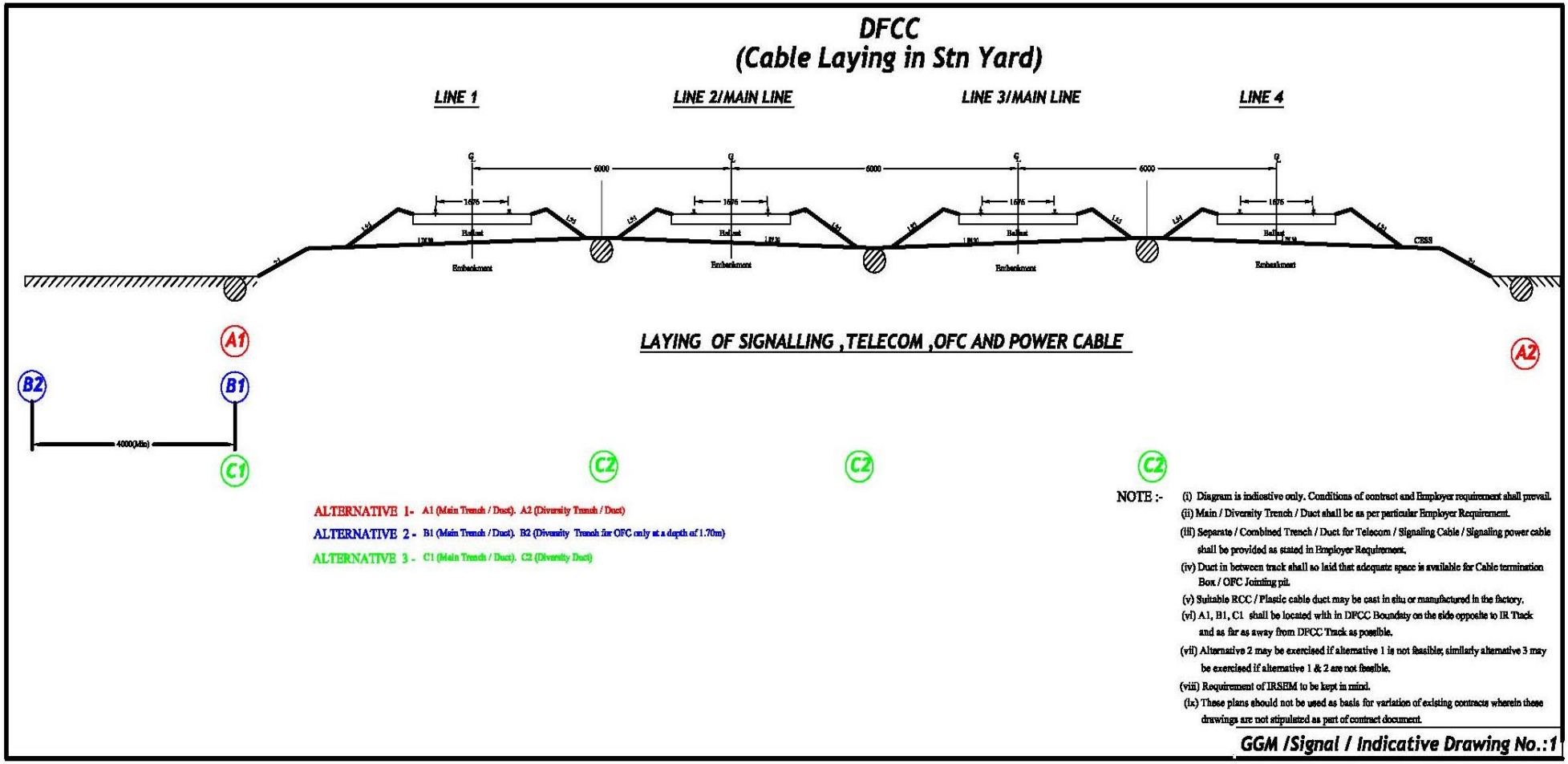
(16) Above joint circular shall be applicable for construction as well as open line organization of Engineering, S&T & Electrical.

(17) The S&T cable and Electrical cable route plan should be got approved from the concerned Sr. DSTE/DSTE & Sr. DEE/DEE respectively, before undertaking the work and completion cable route plan should be finalized Block section by Block section as soon as the work completed.

NOTE: Various designations mentioned in the above Joint Procedure Order are for Railways. In the DFCCIL work, all approvals/inspections will be by the Engineer rather than the designated officials mentioned in the above Joint Procedure Order.

End of Annexure I of Appendix 4

Annexure-II(a) of Appendix 4



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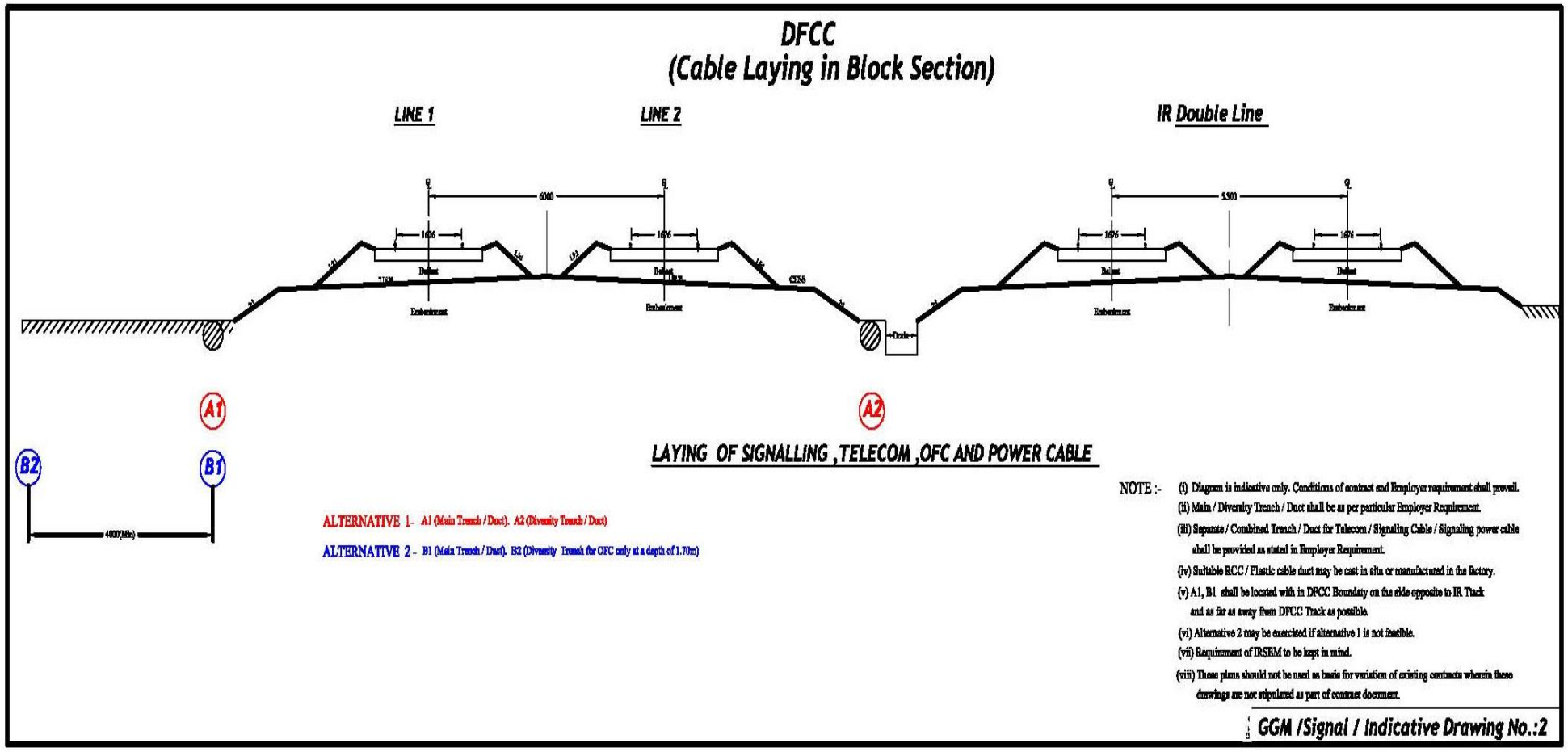
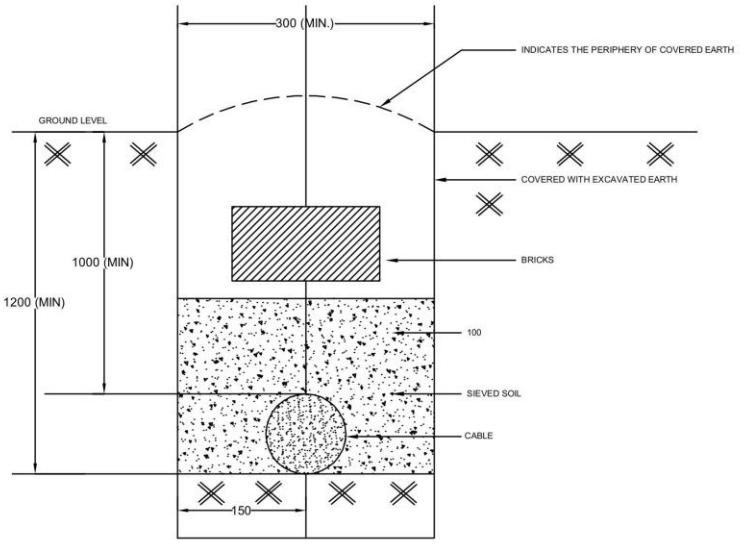


Annexure III of Appendix 4



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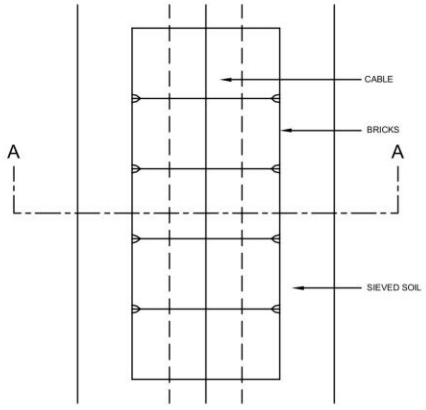
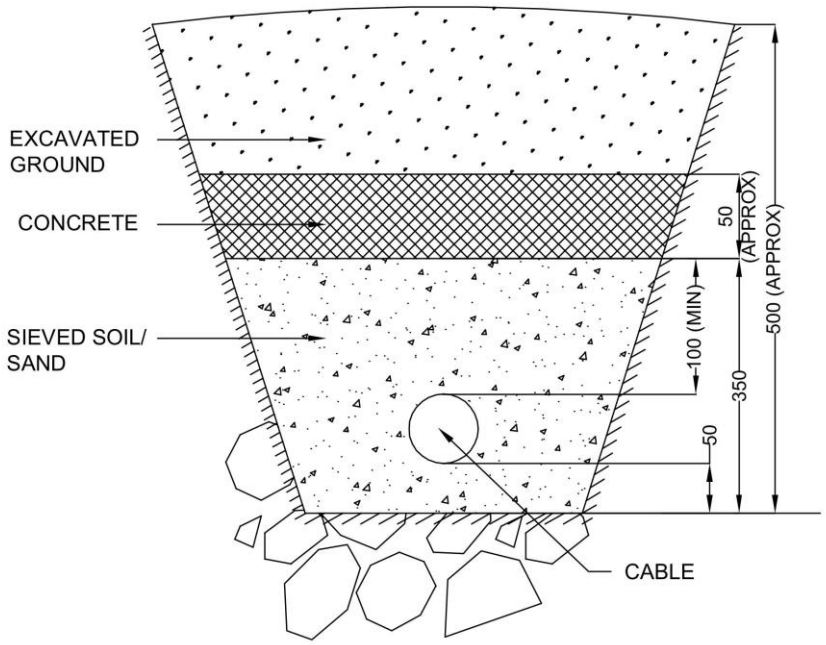


PLAN VIEW

NOTE:-
ALL DIMENSIONS ARE IN MILLIMETER.

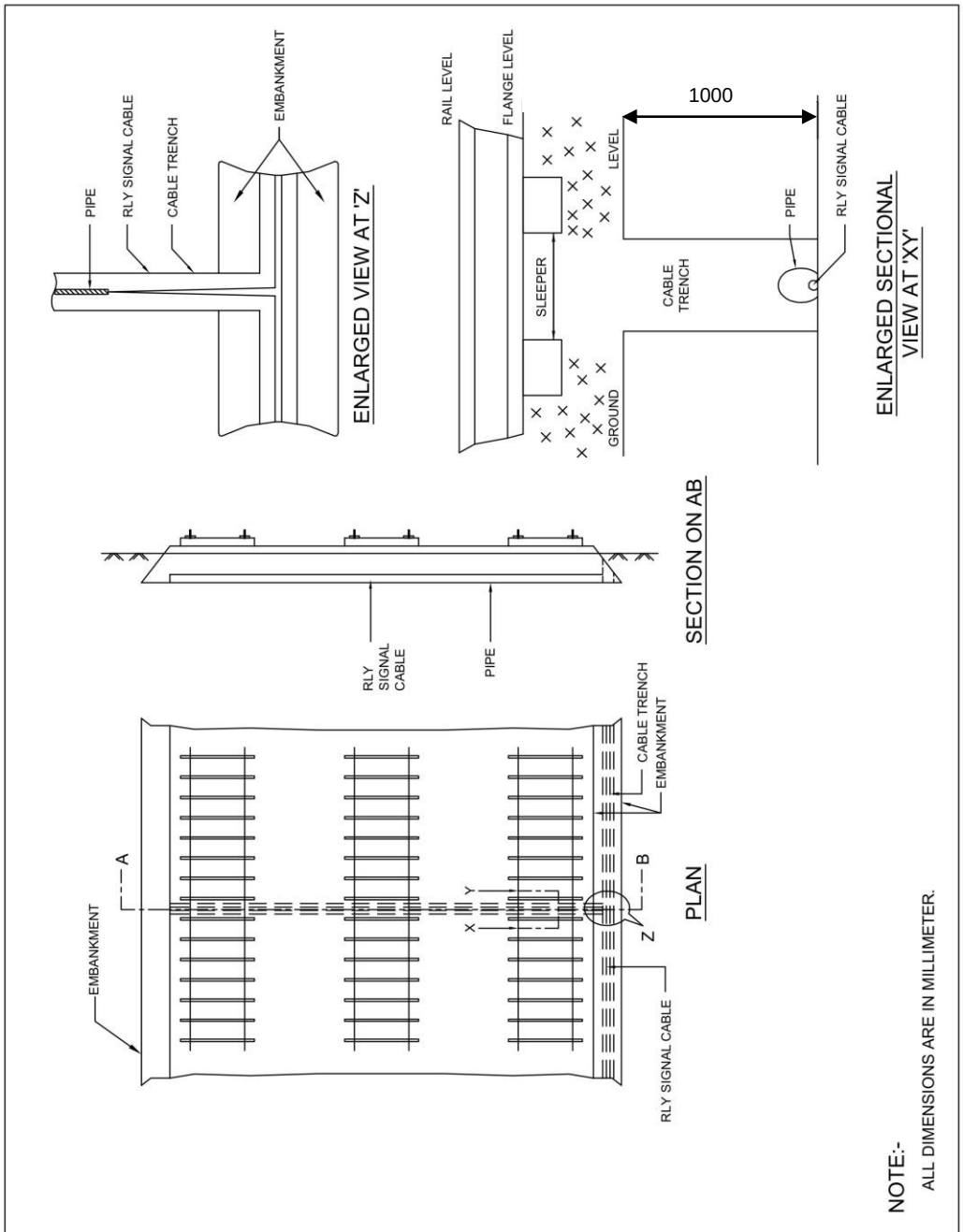
CHECKED BY	JE/SE/SSE	CABLE TRENCH	SDO/CABLE LAYING/003
APPROVED BY	ADE	RDSO	DATE : 31-10-2011
NOT TO SCALE			

Annexure-IV of Appendix 4



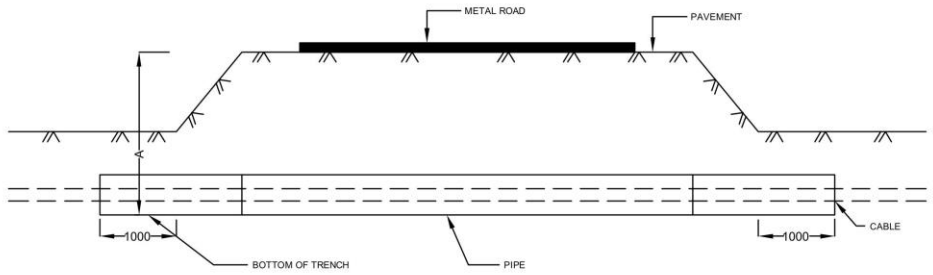
CHECKED BY	JE/SE/SSE	LAYING OF CABLES IN ROCKY AREA	SDO/CABLE LAYING/008
APPROVED BY	ADE	RDSO	DATE : 31-10-2011
NOT TO SCALE			

Annexure-V of Appendix 4



CHECKED BY	JE/SE/SSE	TRACK CROSSING	SDO/CABLE LAYING/009
APPROVED BY	ADE	RDSO	DATE : 31-10-2011
NOT TO SCALE			

Annexure-VI of Appendix 4



ALL DIMENSIONS ARE IN MILLIMETER.

CHECKED BY	JE/SE/SSE	ROAD CROSSING	SDO/CABLE LAYING/010
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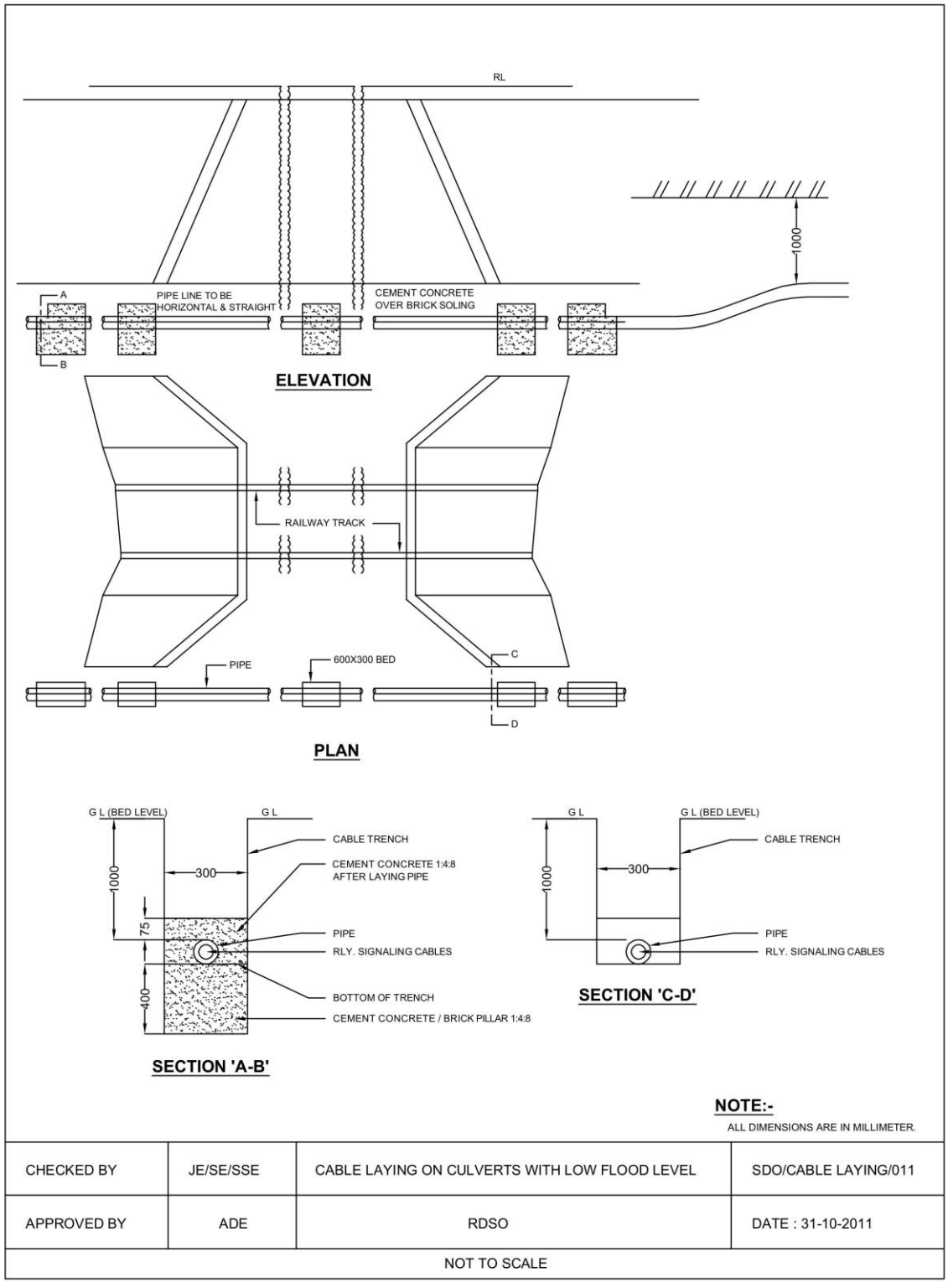
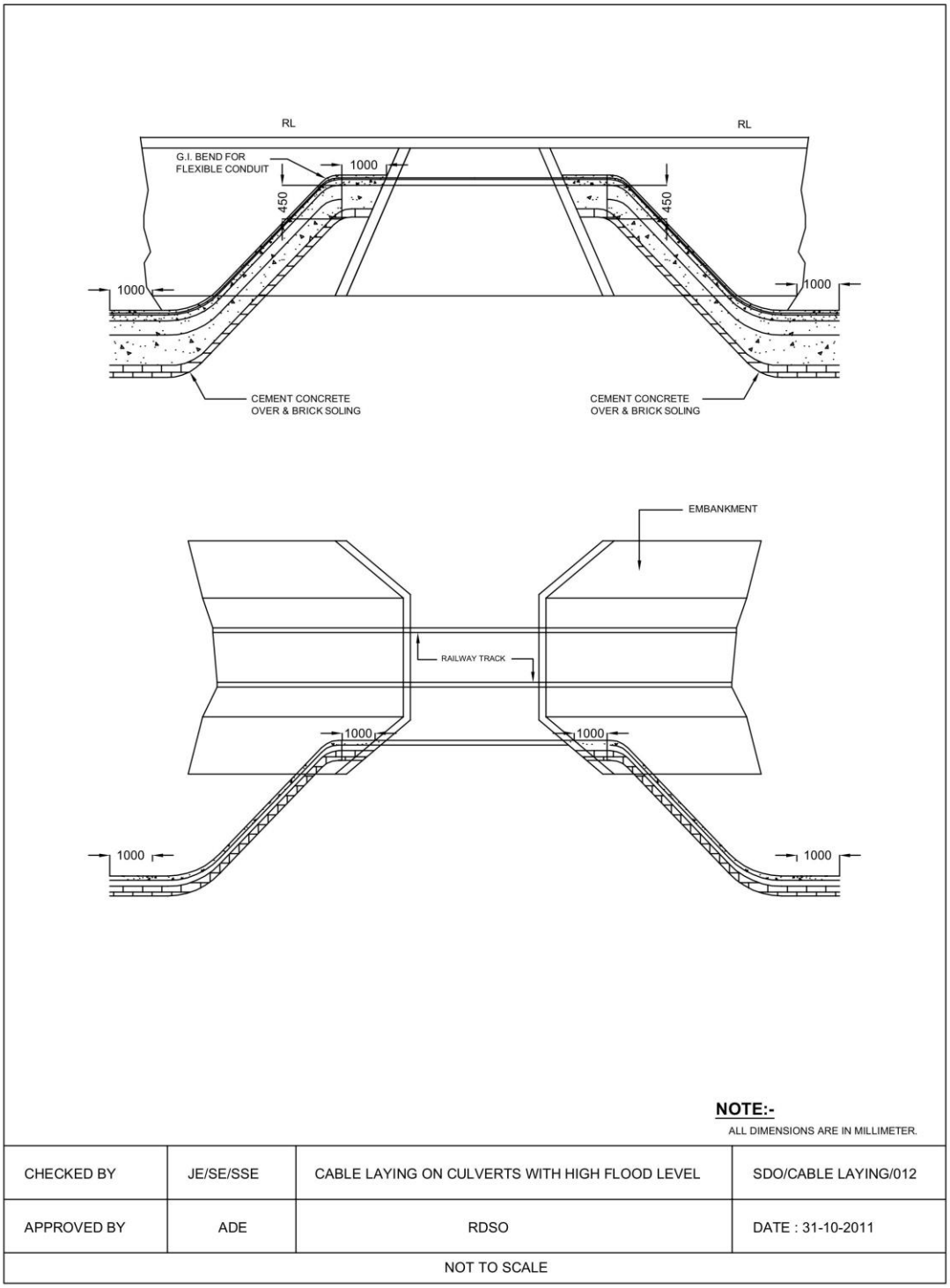
NOT TO SCALE			

Annexure-VII of Appendix 4



CHECKED BY	JE/SE/SSE	CABLE LAYING ON CULVERTS WITH LOW FLOOD LEVEL	SDO/CABLE LAYING/011
APPROVED BY	ADE	RDSO	DATE : 31-10-2011
NOT TO SCALE			

Annexure-VIII of Appendix 4



NOTE:-
ALL DIMENSIONS ARE IN MILLIMETER.

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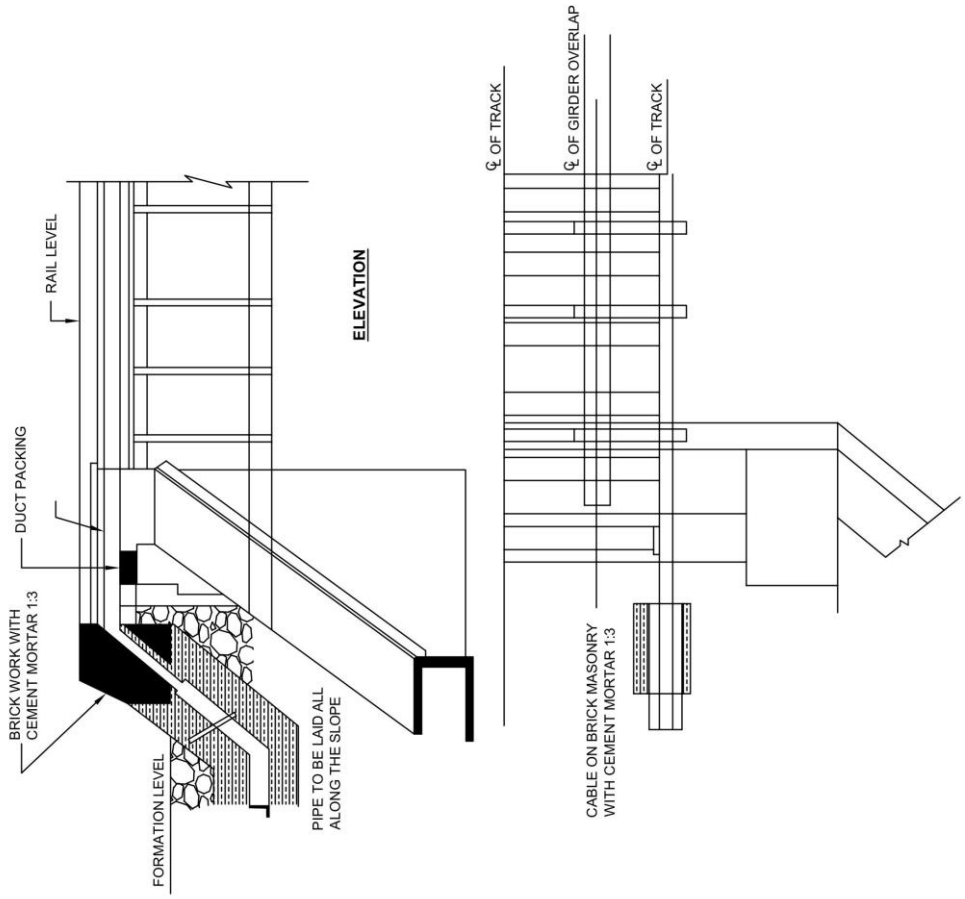
NOT TO SCALE			

Annexure-IX of Appendix 4

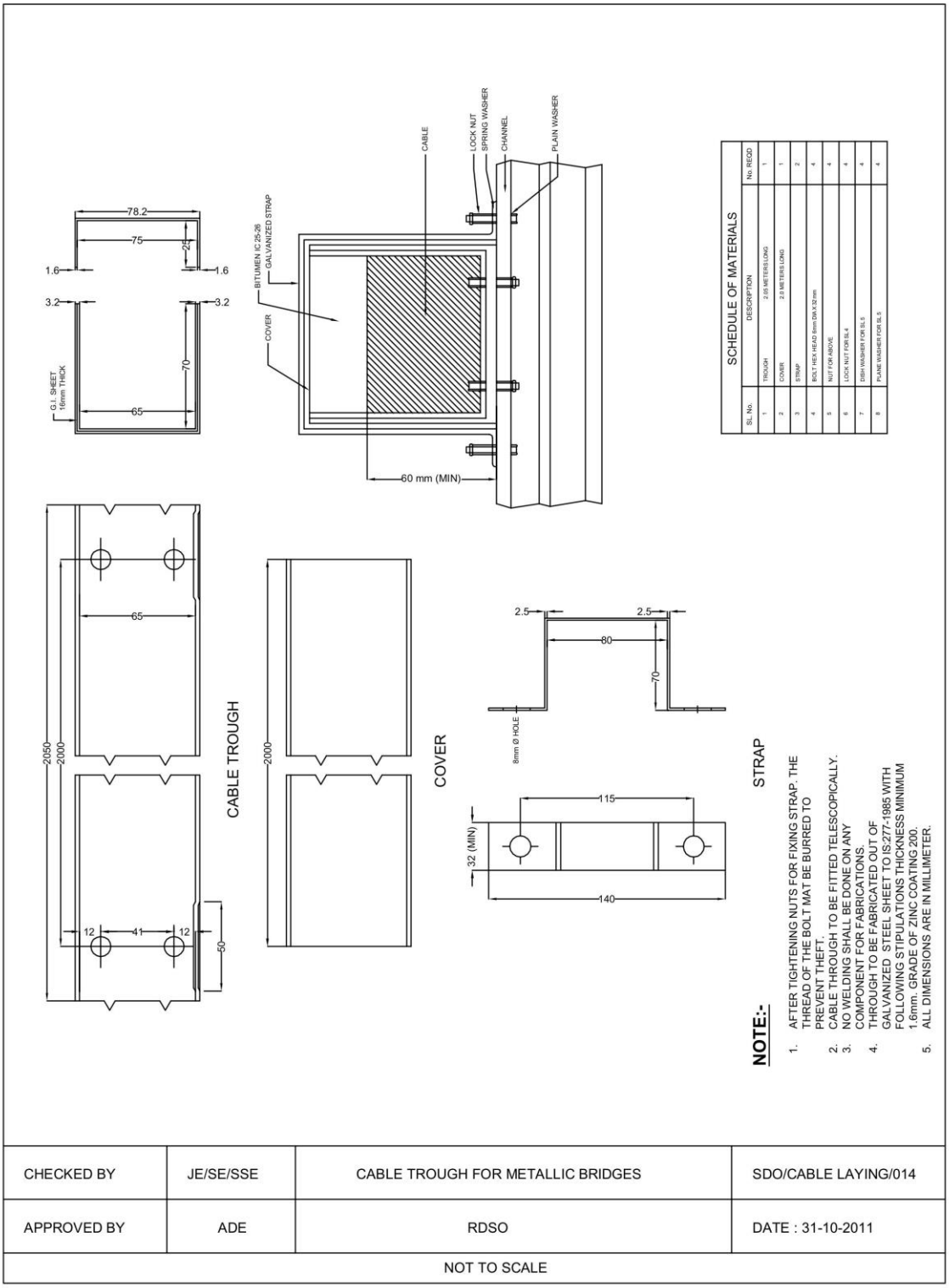


NOTES:-

1. SECOND CHANNEL SHOULD BE FIXED BY SIDE ALONG WITH FIRST TROUGH FOR LAYING SIGNALLING CABLE.
2. LOCATIONS OF CHANNELS ALONG WITH THE GIRDER BRIDGES TO BE DECIDED AFTER SITE SURVEY. HOWEVER, EACH TROUGH JOINT TO BE SUPPORT ON CHANNEL.
3. ALL DIMENSIONS ARE IN MILLIMETERS.

CHECKED BY	JE/SE/SSE	CABLE LAYING ON METALLIC BRIDGES	SDO/CABLE LAYING/013
APPROVED BY	ADE	RDSO	DATE : 31-10-2011
NOT TO SCALE			

Annexure-X of Appendix 4



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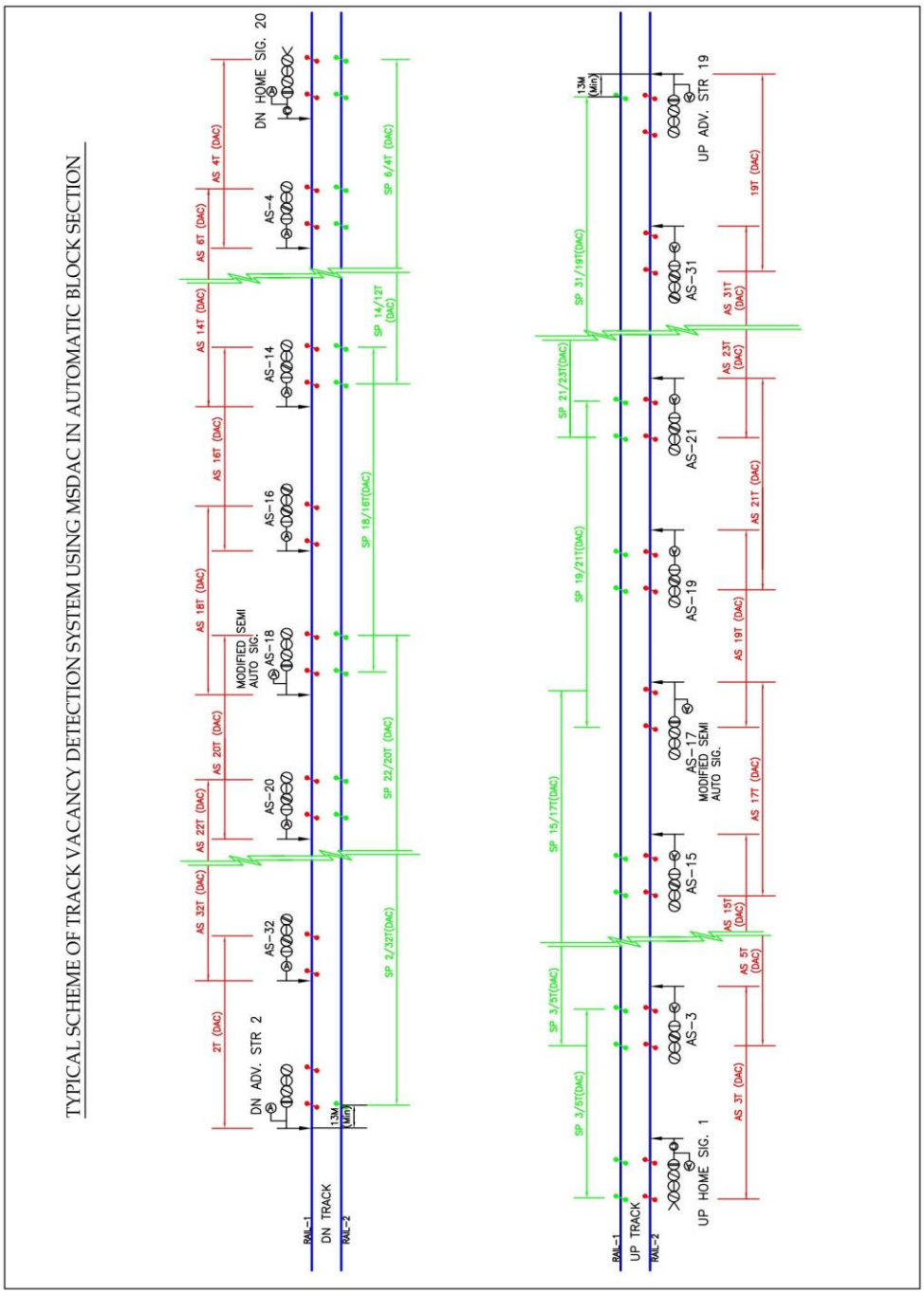
NOT TO SCALE			

Appendix 5

Typical Scheme of Track Vacancy Detection System Using MSDAC in Automatic Block Section



(End of Appendix 5)

Appendix 6

Earthing& Bonding Connections

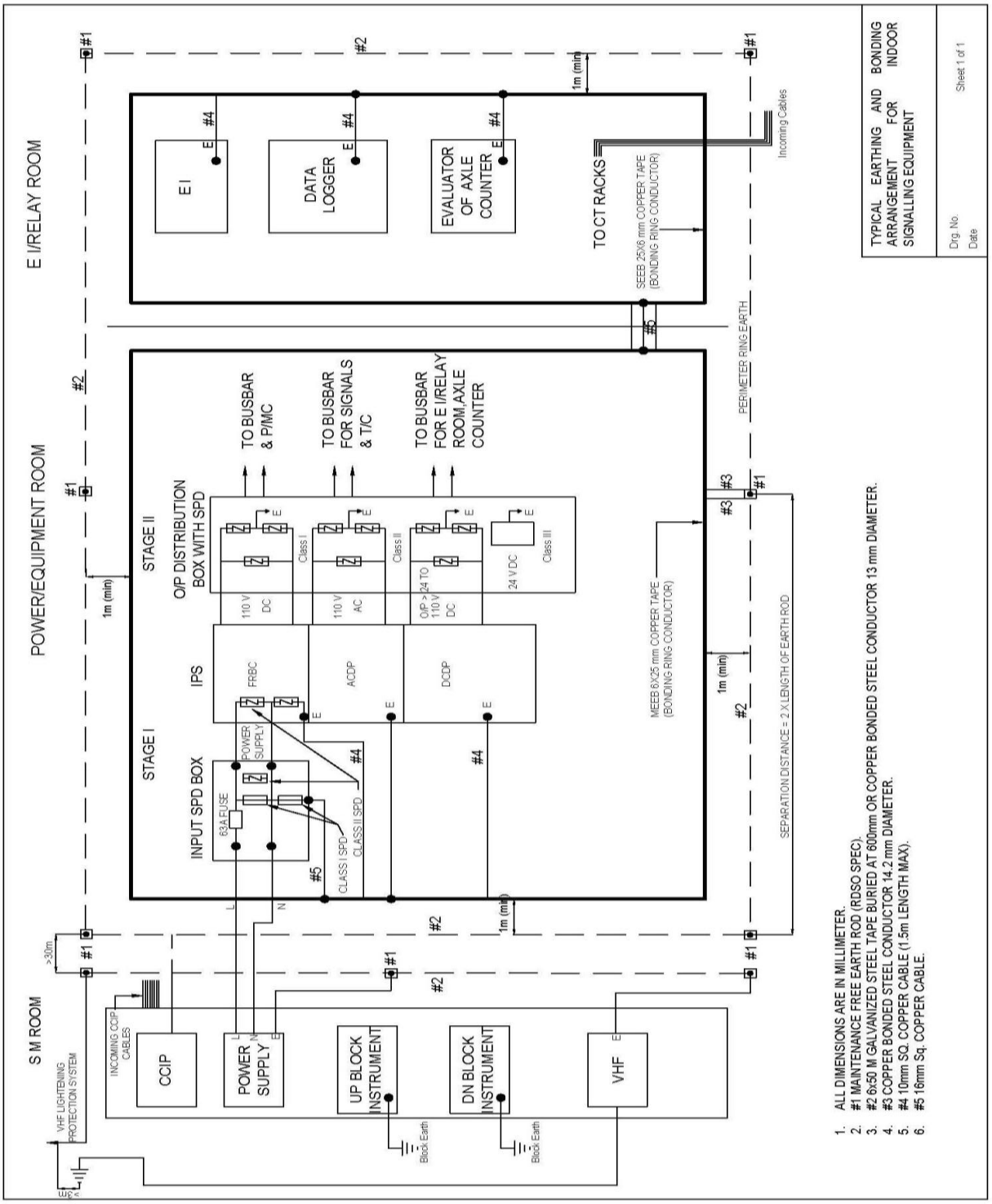
Earthing & Bonding connections Drawing for:

(1) Typical Earthing and Bonding arrangement for Indoor Signalling equipment - Annexure-I of Appendix 6

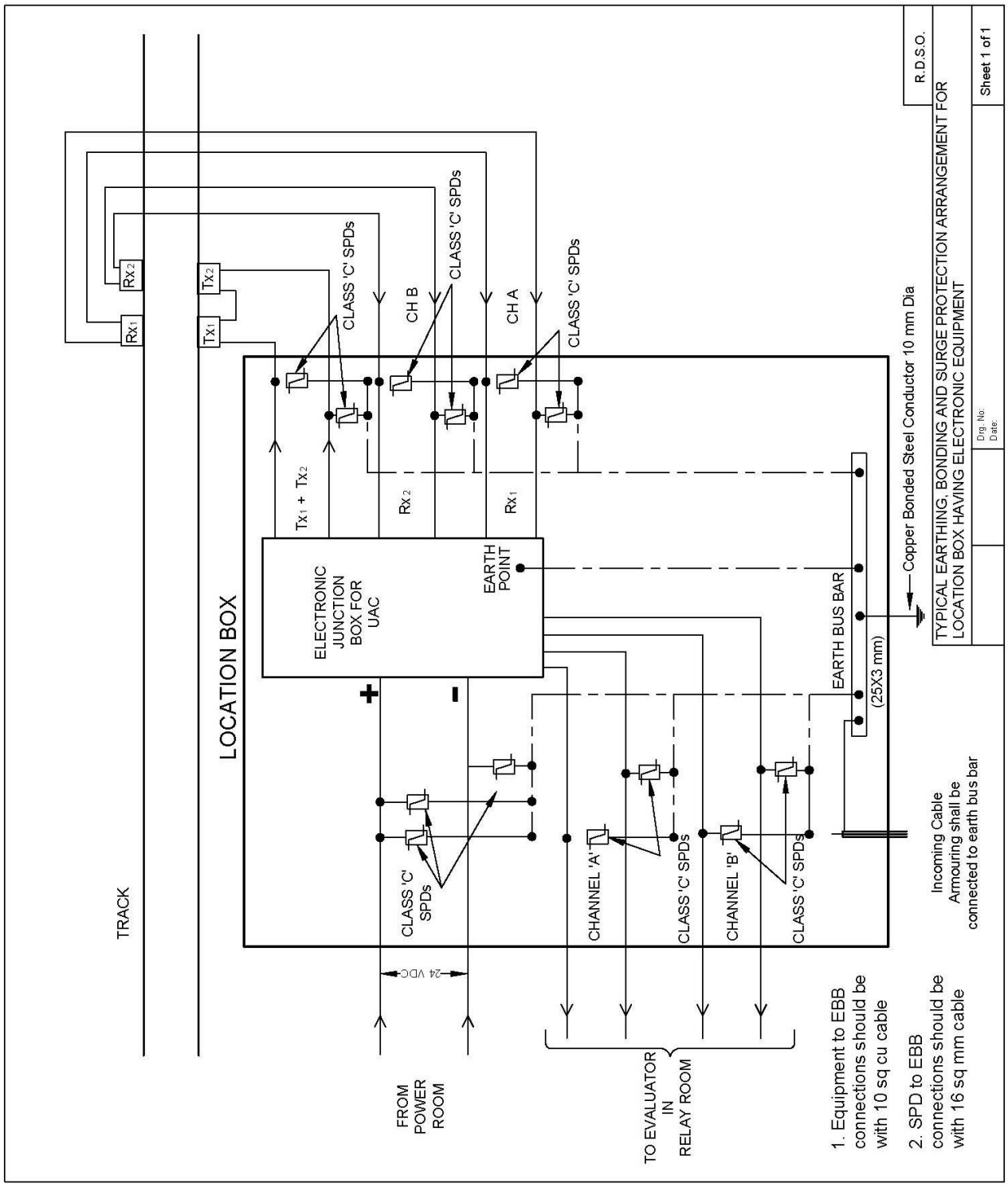
(2) Typical Earthing, Bonding and Surge Protection arrangement for Location Box having Electronic Equipment – Annexure-II of Appendix 6.

Note: The sketches' given are indicative. The detailed drawings shall be proposed by the Contractor and approved by the Engineer.

Annexure-I of Appendix 6



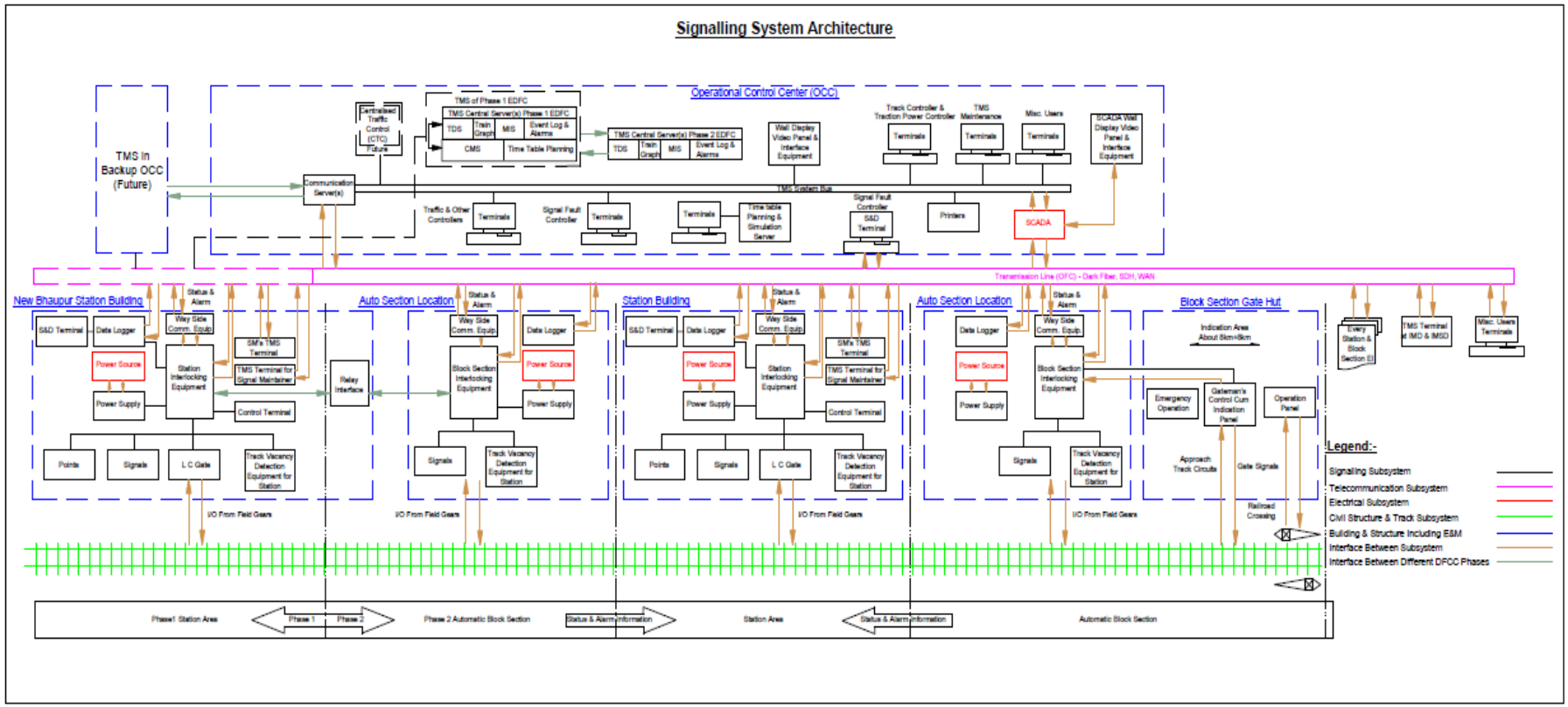
Annexure-II of Appendix 6



(End of Appendix 6)

Appendix 7

Signalling System Architecture



(End of Appendix 7)

डेडीकेटेड फ्रेट कोरीडोर

BID DOCUMENT FOR

BALANCE WORKS OF DESIGN, SUPPLY, CONSTRUCTION, TESTING AND COMMISSIONING OF SIGNALLING, TELECOMMUNICATION AND ASSOCIATED WORKS OF DOUBLE TRACK RAILWAY LINES UNDER CONSTRUCTION ON A DESIGN BUILD LUMP SUM BASIS FOR DEEN DAYAL UPADHYAY - NEW BHAUPUR SECTION OF EASTERN DEDICATED FREIGHTCORRIDOR

SIGNALLING AND TELECOMMUNICATION WORKS

CONTRACT PACKAGE: 203(R)

Issued on: 27.08.2020

IFB No.: HQ/S&T/EC/D-B/DDU-BPUN

Part-2, Section V(B), Volume 8

Particular Specifications

Telecommunication Works

Employer:

DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LIMITED

A GOVERNMENT OF INDIA ENTERPRISE

under

MINISTRY OF RAILWAYS

INDIA

PARTICULAR SPECIFICATIONS: TELECOMMUNICATION WORKS

Table of Contents

CHAPTER 1 - INTRODUCTION

1.1 General

1.1.1 Phase-2 of Eastern Dedicated Freight Corridor (hereinafter will be called EDFC Phase-2) Project is construction of 25 kV AC, AT Feeding, Electrified Double Track in Deen Dayal Upadhyay-New Bhaupur Section.

1.1.2 The EDFC Phase-2 will have 6 Crossing Stations and 6 Junction Stations. The Junction Stations will be connected to IR stations through single line tracks. The trains from/to Indian Railways will enter/exit the EDFC Phase-2 at these five Junction Stations. Details of these Crossing Stations and Junction Stations are given in General Specifications.

1.1.3 There will be 15 Level Crossings Gates in the EDFC Phase-2. These gates will be manned and interlocked & protected by Gate Signals. Details of these 15 Level Crossings Gates are given in General Specifications.

1.1.4 Control and Monitoring of Traction Power in the EDFC Phase-2 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 General Specifications.

1.1.5 In EDFC Phase-2, Integrated Maintenance Depots (IMDs) have been planned at Deen Dayal Upadhyay, New Karchana and New Kanpur and Integrated Maintenance Sub Depots (IMSDs) have been planned at New Dagmagpur, New Unchdih, New Manauri, New Rasulabad and New Malwan stations. These depots will have maintenance facilities for all the concerned departments viz. Electrical, Civil, Signalling and Telecommunication.

1.1.6 In EDFC Phase-2, residential complexes have been planned for its staff. A total no. Of 263 Residential Quarter/Houses shall be constructed in Deen Dayal Upadhyay -New Bhaupur Section. In addition one Guest House and one Club/Institute have also been planned at Allahabad.

1.1.7 A centralized Operational Control Centre (OCC) for the entire Eastern Dedicated Freight Corridor (Ludhiana-Khurja-Dadri-Bhaupur-Deen Dayal Upadhyay-Dankuni), i.e. including EDFC Phase-2 is located at Allahabad. The OCC shall house the Train Management System and Traction Power SCADA for entire EDFC. All the controllers viz. Chief Controllers, Deputy Chief Controller, Assistant Controller, Traffic Controllers, Track Controller, Traction Power Controller and Signalling Fault Management Controller shall monitor and manage all train operations and associated activities, including maintenance of entire EDFC from the OCC.

1.1.8 Communication and Control Signals for both Signalling & Telecommunications shall be distributed around the EDFC Phase-2 via an Optical Fibre Data Transmission Network.

1.2 Purpose

1.2.1 This Specification covers the Design, Manufacturing, Delivery, Installation, Testing & Commissioning and Defects Notification Period Support for the Telecommunication System to be supplied under this Contract.

1.2.2 The Main Purpose of the Telecommunication System shall be to provide Voice and Data Transmission Capabilities throughout the EDFC Phase-2 to enable efficient operation and management of the Railway System. In addition, the Telecommunication System shall be required to distribute an accurate Time Signal throughout the EDFC Phase-2.

1.2.3 Telecommunication System shall also meet all the Data Communication requirements of Signalling and Electrification Works.

1.3 Scope Of Work

1.3.1 General Requirements

1.3.1.1 The Telecommunication System shall be designed, manufactured, supplied, delivered, installed, tested and commissioned by the Contractor under this Contract to meet all the requirements as defined in this Particular Specifications.

1.3.1.2 The Telecommunication System shall include, but not be limited to, the Sub-systems namely, Optical Fibre Communication System, Data Networking System, Telephone System, GSM-R based Mobile Train Radio System, , Master Clock System, VHF Communication System and associated 48 V DC Power Supply System, Spares, special Tools and Test Equipment, Lightening, Surge Protection and Earthing System,

1.3.1.3 The scope shall include erection of towers in detour portion of the track near BTS as defined in this Particular Specifications.

1.3.1.4 The scope shall also include any upgradation/augmentation/reconfiguration, as required, of equipment provided under Contract Package CP-104 to meet the requirements as defined in this Particular Specifications.

1.3.2 Scope of Supplies

1.3.2.1 The scope of supply shall include all necessary Hardware, Software, Firmware, Accessories, Materials and Documentation for Telecommunication System. The detailed requirements shall be as given in this Particular Specification.

1.3.2.2 The scope of supply shall also include supply of Spares and Tools & Test Equipment as stipulated in this Particular Specification.

1.3.3 Scope of Services

1.3.3.1 The scope of services to be performed by the Contractor shall include -- Design, Manufacturing, Delivery, System Assurance, Storage, Installation, Testing and Commissioning of the Telecommunication System. The scope of services to be performed by the Contractor shall include but not be limited to the following-

- Presentations, reviews and audit support as specified in the Specification;
- Project Management of the implementation of the System;
- Quality and Safety Management;
- Overall site supervision and management;
- Decommissioning, removal and disposal of Temporary Works;
- Operation & Maintenance support services;
- Preparation and submission of documentation;
- Training for Employer's Training Instructors, operations staff, maintenance staff and engineering staff;
- Provision of spares, tools and test equipment;
- Interface Management;
- Manpower resources;
- Prototypes, mock-ups, emulation and simulation as required

1.3.3.2 The scope of services shall also include, but not limited to, Project Management, Interface Management, Quality Management, System Assurance Management, Safety Management, EMC Management, Design, Procurement & Manufacturing Management, Construction & Installation Management, Overall Site Supervision & Management, SHE Management, Completion Management, Defect Liability Management, etc.

1.3.3.3 The scope of services shall also include Maintenance Support Services including rectification & removal of defects during the Defect Notification Period and Training for Employer's Personnel.

1.4 Relevant Documents

1.4.1 This Particular Specification (PS) shall be read in conjunction with the Conditions of Contract, the General Specification (GS), and any other document forming part of the Contract.

1.4.2 In the event of a conflict between the GS and the PS (Telecommunication Works), the requirements of the PS (Telecommunication Works) shall prevail.

1.4.3 In the event of a conflict between this document and others, the following precedence shall apply:

(1) This Document-Particular Specification (Telecommunication Works).
(2) General Specification.
(3) Indian Standards referenced in this document.
(4) International Standards referenced in this document.
(5) Other International Standards.
(6) Other National Standards.

1.4.4 Notwithstanding the contents of sections above, the Contractor shall always immediately seek advice from the Engineer in the event of conflicts between specifications and decision of the Engineer shall be final and binding.

1.5 Infringement of Patent Rights

1.5.1 The Employer will 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 Telecommunication system and any other factor not mentioned herein which may cause such a dispute. The entire responsibility to settle any such dispute/matters shall lie with the Contractor.

1.6 Contractor's Responsibility for Discrepancy: -

1.6.1 All designs and drawings submitted by the contractor shall be based on a thorough study and shall be such that the contractor is satisfied about their suitability. The Engineer's approval will be based on these considerations, notwithstanding the approval Communicated by the Engineer, during the progress of the contract for designs and drawings, prototype samples of components, materials and equipment after inspection of materials, after erection and adjustments to installations. The ultimate responsibility for correct design and execution of work shall rest with the contractor.

1.6.2 The contractor shall be responsible for and shall bear and pay the costs for any alteration of works arising from any discrepancies, errors or omissions in the design and drawings supplied by him, whether such designs and drawings have been approved by the Engineer or not.

∗ End of Chapter 1 ∗

CHAPTER 2 – ABBREVIATIONS & STANDARDS

2.1 Abbreviations

ACL	Access Control List
ALARP	As Low As Reasonably Practicable
ALH	Auto Location Hut
ADM	Add Drop Multiplexer
ALARP	As Low As Reasonably Practicable
ASP	Audio and Selection Panel
ATP	Automatic Train Protection
BGP	Border Gateway Protocol
BOQ	Bill of Quantity
BSC	Base Station Controller
BHCA	Busy Hour Call Attempt
BLSR	Bi-directional Line Switched Ring
BSS	Base Station Sub system
BTS	Base Transceiver Station
CBS	Cell Broadcast Service
CD	Commercial Dispatcher
CENELEC	European Committee for Electro-technical Standardization
CI	Cell Identifier
CISPR	International Special Committee on Radio Interference
CLIP	Calling Line Identification Presentation
CILR	Calling Line Identification Restriction
C/I	Carrier to Interference Ratio
CLK	Clock System
CS	Control Superintendent
CSMA/CD	Carrier Sense Multiple Access / Collision Detection
CSS	Central Security System

CTCSS	Continuous Tone coded Squelch System
DCS	Digital Coded Squelch
DDF	Digital Distribution Frame
DI	Digital Input
DOT	Department of Telecommunication, Ministry of Communication & Information Technology, Govt. of India
DLP	Defect Liability Period
DTS	Data Transmission System
DC	Direct Current
DFC	Dedicated Freight Corridor
DFCC	Dedicated Freight Corridor Corporation
DHCP	Dynamic Host Configuration Protocol
DID	Direct Inward Dial
DNP	Defect Notification Period
DOD	Direct Outward Dial
DOT	Department of Telecom, Government of India
DLT	Direct Line Telephone
DTMF	Dual Tone Multiple Frequencies (Signalling)
DTN	Data Transmission Network
DWC	Double Wall Corrugated
ECS	Environmental Control System
ECV	End Cell Voltage
EIR	Equipment Identification Register
EMLPP	Enhanced Multi level Precedence and Pre-emption Service
E&M	Ear and Mouth
EPABX	Electronic Private Automatic Branch Exchange
ERTMS	European Rail Traffic Management System
EDFC	Eastern Dedicated Freight Corridor
EIRENE	European Integrated Railway Radio Enhanced Network

EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
E&M	Electrical & Mechanical
EN	European Norm
EoS	Ethernet over SDH
EPL	Ethernet Private Line
EVPL	Ethernet Virtual Private Line
E-LAN	Ethernet Local Area Network
EoMPLS	Ethernet over MPLS
ETCS	European Train Control System
ETSI	European Telecommunication Standards Institute
FRS	Functional Requirement Specifications
FAT	Factory Acceptance Tests
FASW	Fast Ethernet Access Switch
FEP	Front End Processor
FXS	Foreign Exchange Subscriber
FXO	Foreign Exchange Office
GCR	Group Call Register
GI	Galvanized Iron
GOS	Grade Of Service
GPS	Global Positioning System
GUI	Graphical User Interface
GSM	Global System for Mobile communication
GSM-R	Global System for Mobile communication – Railway
HCS	Hundred Call Seconds
HDPE	High Density Polyethylene
HDLC	High Level Data Link Control Protocol
HLR	Home Location Register
HSRP	Hot Standby Router Protocol

ID	Identification
IMD	Integrated Maintenance Depot
IMSD	Integrated Maintenance Sub-Depot
IS-IS	Intermediate System to Intermediate System
IAP	Integrated Audio Panel
IDC	Insulation Displacement Connection
IEC	International Electro-technical Commission
ICT	Information and Communication Technology
ISDN	Integrated Services Digital Network
ITU-R	International Telecommunications Union – Radio communication Sector
IGMP	Internet Group Management Protocol
IEC	International Electro-technical Commission
IEEE	Institute of Electrical and Electronics Engineers
IOT	Inter-Operability Test
IP	Internet Protocol
IR	Indian Railways
IRS	Indian Railways Standards
ISDN	Integrated Services Digital Network
ITU	International Telecommunication Union
ITU-T	International Telecommunications Union – Telecommunication Standardization Sector
KMPH	Kilo Meter Per Hour
LAN	Local Area Network
LC	Level Crossing
LCD	Liquid Cristal Display
LCP	Local Control Panel
LCX	Leaky Coaxial Cable
LDP	Label Distribution Protocol

L2PT	Layer 2 Protocol Tunneling
LED	Light-Emitting Diode
MDF	Main Distribution Frame
MEP	Mechanical Electrical Planning
MMI	Man Machine Interface
MPLS	Multi-Protocol Label Switching
MS	Mobile Subscriber
MSC	Mobile Switching Centre
MTBF	Mean Time Between Failure
MS-SPRING	Multiplex Section Shared Protection Ring
MTRC	Mobile Train Radio Communication
MTTR	Mean Time To Repair
NMS	Network Management System
NTP	Network Time Protocol
O&M	Operating and Maintenance
OA	Office Automation
OCC	Operation Control Centre
OCS	Overhead Contact System
ODF	Optical Distribution Frame
OFC	Optical Fibre Cable
OEM	Original Equipment Manufacturer
OSI	Open System Interconnection
OSPF	Open Shortest Path First
OMS	OTN Management System
PABX	Private Automatic Branch Exchange
PAL	Phase Alternation by Line
PBX	Private Branch Exchange
PCM	Pulse Code Modulation
PDH	Plesio-chronous Digital Hierarchy

PI	Pulse Input
PIJF	Paper Insulated Jelly Filled
PLC	Programmable Logic Controller
POP	Point of Presence
PSTN	Public Switched Telephone Network
PTT	Press To Talk
QoS	Quality of Service
RA	Remote Access
RAMS	Reliability, Availability, Maintainability and Safety
RCIL	Railtel Corporation of India Limited
RDSO	Research Design and Standards Organization
RE	Railway Electrification/Electrified
RH	Relative Humidity
RDC	Radio Dispatcher Console
REC	Railway Emergency Call
RF	Radio Frequency
RMON	Remote Monitoring
RSI	Repetitive Strain Injury
RTU	Remote Terminal Unit
SAT	Site Acceptance Tests
SC	Station Controller
SCADA	Supervisory Control and Data Acquisition
SCR	Station Controller Room
SDH	Synchronous Digital Hierarchy
SHE	Safety, Health and Environment
SIL	Safety Integrity Level
SINAD	Signal to Noise And Distortion Ratio
SM	Single Mode
SMS	Station Management System

SMS	Short Message Service
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
S&T	Signalling & Telecommunication
TDM	Time Division Multiplexing
TBC	Train borne Communications
TCCP	Train Cab Communication Panel
TD	Traffic Dispatcher
TDMA	Time Division Multiple Access
TER	Telecommunication Equipment Room
TFT-LCD	Thin Film Transistor – Liquid Cristal Display
TMS	Train Management System
STM	Synchronous Transport Module
TCP/IP	Transmission Control Protocol / Internet Protocol
TMN	Telecommunications Management Network
TPC	Traction Power Controller
T-LDP	Targeted Label Distribution Protocol
TSS	Traction Sub-Station
TRAU	Trans-coder Rate Adaption Unit
TRX	Transceiver
UPS	Uninterruptible Power Supply
UPSR	Uni-directional Path Switched Ring
UTC	Universal Time Co-ordinate
VBS	Voice Broadcast Service
VC	Virtual Container

VCC	Vehicle Communication Controller
VDU	Video Display Unit
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
VSWR	Voltage Standing Wave Ratio
WAN	Wide Area Network
WPC	Wireless Planning Committee

2.2 List of standards/Specifications

STANDARDS/SPECIFICATIONS	TOPIC
IEC 62278	RAMS
EN 50121, IEC 61000	EMC - Intra & Inter System
EN 50121, IEC 61000	EMI – Equipment is adequately protected against EMI, EMC – EMC testing
ITU-T Rec. 803	Proven SDH technology
EN-50159	All vital & safety related information shall be implemented as per this standard in both First & Second OFC network
G.7041	SDH equipment shall be equipped with EoS at 10/100 Base T
IEEE 802.1d	Re: In-built Layer-2 Bridging & Aggregation functionality
IEEE 802	Layer-3, Layer-2 switches shall support: IEEE 802.3ad – Link aggregation control IEEE 802.1Q – VLAN on all ports

	IEEE 802.1q – VLAN (tagging) IEEE 802.1x – Port based authentication IEEE 802.1d – Spanning Tree Protocol IEEE 802.1s – Multiple Spanning Tree Protocol IEEE 802.1w – Rapid Spanning Tree Protocol
IEEE 802	Layer 2 Switch IEEE 802.3 – Support Half Duplex IEEE 802.3u – Full Duplex IEEE 802.3ab – Auto Negotiation
RFC 2138	For DHCP, RADIUS Protocol
IEEE 802.1p	Classification & Scheduling on all ports
IEEE 802.1x	Access control mechanism via Authentication, Authorization & Cryptographic key Validation
RDSO/SPN/TC/66/2007	Control Communication System shall have equipment as per RDSO specs
RDSO Spec: IRS: TC 30-05 or Latest	Underground Jelly Filled Telecom Quad cable
IEC 60065 IEC 60364	All equipment must comply to System Safety Requirement
ITU-T Rec. G.822	Allowable clock slip in PBX network internal clock when Master Clock is absent
RDSO Spec: IRS: TC 41-97 or Latest	Spec of Polythene Insulated Jelly Filled Cable
EIRENE FRS 7.3 EIRENE SRS15.3	MTRC
RDSO Letter: STT/WL/MTRC/503 Dated 11.11.2005	Numbering Plan
IEC 60950	Safety of Information Technology Equipment
IEC 60364	Electrical Installations of Buildings
EIA/TIA–222-E IS 800,808, 226/2062/ 1367,1161, 2629,5358	Antenna Tower at Radio Base Station
IS 4759	Hot dipped galvanized iron compliance for towers
IEEE 802.3af	PoE
RDSO/SPN/TL/23/99 Ver 4.0 or Latest	Spec for battery chargers
RDSO Spec: IR S93-96 TEC Spec: GR/BAT-01/03 March 2004	VRLA battery cells

ITU-T Rec. G.652	ODF: Optical connectors compliance
IEC62305 IEC62561 IEC60364	Earthing System Standards
ITU-T M-3010	ITU-T Recommendation on Principles for Telecommunication Management Network.
ITU-T Rec. G.823	ITU-T Recommendation on Control of Jitter and Wander in 2 Mbps Digital Network
ITU-T Rec. G.825	ITU-T Recommendation on Control of Jitter and Wander in SDH Digital Network
ITU-T Rec. G.712	ITU-T Recommendation on Transmission performance characteristics of pulse code modulation channels
ITU-T Rec. G.821	ITU-T Recommendation on Error performance of an international Digital Connection
RDSO Spec: IRS: TC 55-2006 or Latest	RDSO specification for 24 F Armoured Optical Fibre Cable
IEC60793 & IEC60874	IEC Specification for Optical Fibres and Connectors

∗ 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 excluding battery cells shall be so designed as to have a minimum of 15 years of Service Life operating continuously. The life of Valve Regulated Lead Acid Battery Cells shall not be less than 7 years. Further, the life of all the cables including Optical Fibre Cables, Jelly Filled Telecom Quad Cable, Telephone Cables and RF Cables shall not be lower than 25 years and life of Radio Towers/Mast shall not be less than 40 years.

3.1.3 The System shall be designed to facilitate freight train and station operation, management of incidents and abnormal operations as well as of emergencies.

3.1.4 The System shall, to the extent practicable, have no credible failure mode, which will directly cause an interruption or delay in the freight 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 CP-104 for EDFC Phase-1 is being upgraded/augmented/reconfigured, the service life of these upgraded/ augmented/reconfigured equipment shall be minimum 15 years from date of commissioning of this upgradation/augmentation/reconfiguration.

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 during Defects Liability Period (DLP) shall not exceed 2 hours. The response time 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 (EMC)

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.

3.6.14 The contractor shall ensure that all Intra system EMI are taken care of through proper design and other measures. All major subsystems shall be tested for emissions and immunities in accordance with the appropriate international standards for equipments operating in Railway environments.

3.6.15 **Inter-system EMC**

(1) The contractor shall ensure that all equipments are designed and constructed in accordance with latest versions of EMC standards including but not limited to EN50082, EN50121, EN 50123, EN50155, IEC60571, IEC61000 or equivalents to ensure proper functioning.

(2) Adequate safety margins between the immunity levels of the Telecommunication Systems and the emission levels of other electrical and electronic equipment must be maintained.

(3) The design of the software shall take into consideration that with the interference injected into the system, it is possible to produce an abnormal condition. For example the program may become "locked up" awaiting a signal which will never arrive (system hang). It is important therefore that the various possible failures are analysed and appropriate actions are taken when failures are detected.

(4) The probabilities of various conditions which could lead to an unreliable operation must be determined wherever applicable.

3.6.16 **Environmental EMC**

(1) The contractor shall ensure that the Telecommunication system is immune to the radiated interference from the various transmitters which are likely to be installed near the sensors, cables and other equipment.

(2) IEC61000-5-6 (Electromagnetic Compatibility, Mitigation of external influences) shall be observed wherever applicable.

∗ 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:

(1) field proven with past successful applications references

(2) conforming to open 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 minimum two stages of Preliminary and Definitive Design. The Design Plan shall define Contractor's policy for the design of works and shall without limitation, define;

(1) The organization of Contractor's design staff with particular reference to the design interfaces in detail;

(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;

(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) The process of formal design review, authorization and approval of design documentation; and

(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 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 Definitive Design for individual Sub-systems shall be developed based on the Preliminary Design for individual Sub-systems and submitted to the Engineer for review. Definitive 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 Definitive Design stage, and shall be included in the Definitive Design Submission for review of Engineer.

4.1.10 The Definitive 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 Definitive Design.

4.1.11 The Definitive Design shall also include Definitive 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:

(1) Estimation of the power consumption and heat dissipation per equipment location.

(2) Prediction of the reliability and availability of the Sub-systems.

4.1.13 Upon approval of Definitive 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, Circuit Diagrams, Termination Plans, Configuration Details and all other associated documents necessary to supplement the design covered in the Definitive 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 millimetres 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 Contractor shall ensure that all comments of the Engineer have been properly incorporated or otherwise resolved before resubmission.

4.2.3 The Contractor shall exercise adequate control to ensure that the number of resubmissions is a minimum.

(1) The following issues shall be addressed during Design Review Meetings:

- Design Progress
- Interface Issues

4.3 Man Machine Interface Design

4.3.1 For all MMIs specially designed or customised for the System, the Contractor shall provide and organise prototypes for demonstration and submission to the Engineer for review prior to implementation.

4.3.2 All MMIs shall be equipped with virus checking and anti-virus protection facilities to prevent from virus infection.

4.3.3 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.

4.4 Submission of Samples

4.4.1 The Contractor shall submit samples to the Engineer for review, when so required and instructed by latter.

4.4.2 The Contractor shall arrange site visits and/or videos for illustration if the items are bulky or impracticable for submission.

4.4.3 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.

4.4.4 All samples submitted to the Engineer shall become the property of the Employer.

4.5 Equipment Design

4.5.1 **General Considerations**

(1) Specific equipment design requirements for individual Subsystems are given in relevant chapters of this Particular Specification.

(2) The offered equipment shall be field proven with past history of successful performance in railway environment.

(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 Freight Corridor Railway System.

(4) All Housing, Enclosures and Cabinets housing outdoor equipment shall be compliant to IP65 for Ingress Protection.

(5) All active equipment shall have LED indications indicating:

(1) Normal operating conditions.
(2) Normal power supply.
(3) Alarm conditions.

(6) RDSO approved communication system (selective calling) between adjacent LC Gate, controlling IR station and both DFC station of concern automatic block section shall be provided and also comply the provision of communication for LC Gate working shall be as per Gate working rule as approved by IR & CRS.

4.5.2 **Fire and Smoke Precautions.**

(1) The cable routes shall be suitably designed to prevent trapping of rubbish which could later become a fire hazard.

(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.

(3) All necessary measures shall be adopted to prevent the creation of hazardous conditions arising out of overheating and/or ignition of cables.

(4) All of the above requirements shall be fully complied with without compromising any of the mechanical or electrical properties of the cables.

(5) Portable Fire Extinguishers shall be provided in Telecommunication Equipment Room/Telecommunication Power Supply equipment Rooms at Stations, Auto Location Hut, LC gates, Interfacing IR Stations, GSM-R Locations, TSSs, SPs, SSPs, IMDs, IMSDs, Staff Residential Colonies etc. Portable fire Extinguishers shall be compliant to NFPA 10 standard and suitable for electrical equipment.

4.6 Environmental Conditions

4.6.1 All equipment shall be protected from damage or degradation in performance due to shock or vibration as experienced in railway environment.

4.6.2 Unless otherwise specified, all indoor Telecommunication Equipment installations shall be designed for operation continuously in environmental temperatures range of -5°C to +55°C.

4.6.3 Telecommunication Equipment Room (TER) at OCC and Stations shall be provided with Air-Conditioning. Provision of Air-Conditioning in TERs at OCC is covered under Contract Package CP-104, while provision of Air-Conditioning in TERs at Stations is covered under Contract Package CP-204. TER at OCC is classified as 'Class-A' and TERs at Stations are classified as 'Class-B1' under Clause 2.5.5 of General Specifications.

4.6.4 Telecommunication Equipment Room (TER) at Auto Location Huts, LC gates, Interfacing IR Stations, GSM-R Locations, TSSs, SPs, SSPs, IMDs, IMSDs, Staff Residential Colonies etc. shall be provided with air-conditioning. Air-Conditioning in TERs at above locations shall be provided by the Contractor under this Contract. TERs at above locations are classified as 'Class-B1' under Clause 2.5.5 of General Specifications.

4.6.5 Telecom Power Supply Equipment Rooms at Stations, Auto Location Huts, LC gates, Interfacing IR Stations, GSM-R Locations, TSSs, SPs, SSPs, IMDs, IMSDs, Staff Residential Colonies etc. 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. Status of temperature of Stations, Auto location huts and LC Gate Goomty and functioning of the temperature-regulator equipment and air-circulation equipment shall be monitored and recorded through Data Logger. These provisions of to regulate temperature and maintain air-circulation shall be provided by Contractor under this Contract. Telecom Power Supply Equipment Rooms at these locations are classified as 'Class-B2' under Clause 2.5.5 of General Specifications.

∗End of Chapter 4 ∗

CHAPTER 5 - OPTICAL FIBRE COMMUNICATION (OFC) SYSTEM REQUIREMENTS

5.1 General

5.1.1 The OFC System shall be a highly reliable system since it shall be the primary means of communications between OCC, Stations, Auto Location Huts, LC Gates, Interfacing IR Stations, GSM-R Locations, TSSs, SPs, SSPs, IMDs, IMSDs, Staff Quarters etc. on which a number of other operationally critical systems will rely.

5.1.2 The OFC System shall provide a high degree of availability and redundancy by operating on two independent optical fibre rings. Proven technology of SDH (Synchronous Digital Hierarchy) as per ITU-T Rec. G.803 (latest version) shall be used.

5.1.3 The OFC System shall be capable to transport all of the user communication requirements. The OFC System shall provide sufficient bandwidth to cater for the communication requirements of various systems under this Contract as well as under Contract Package CP-204 and shall provide an additional spare bandwidth of at least 50% of the total used bandwidth for future system expansion.

5.1.4 This OFC system shall be integrated with OFC System being provided under Contract Package CP-104 for New Bhaupur-New Khurja section.Whenever existing equipment provided under Contract Package CP-104 are upgraded/augmented/reconfigured 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/reconfiguration they shall meet the Technical Requirement and Performance Requirement as stipulated in this Particular Specifications.

5.2 Scope of Supply for OFC System

5.2.1 The scope of supply shall include, but not be limited to, the following:

(1) SDH Equipment;
(2) Flexible Access Multiplex Equipment;
(3) Network Management System for OFC System;
(4) All required software and licenses;
(5) Single Mode Optical Fibre Cables;
(6) Splice Boxes;
(7) Distribution Frames;
(8) Equipment Cabinets, Racks and Cubicles;
(9) Terminating and Interconnecting Equipment; including Termination Protection Devices
(10) All required connectors;
(11) Installation materials;
(12) All required accessories;
(13) All required power and data cables; and
(14) Power supply and all other data cables, Earthing Arrangement and Termination Protection Devices;
(15) Spare; and
(16) Test instruments and Tools;

5.3 System Requirements

5.3.1 The OFC System shall be a Synchronous Digital Hierarchy (SDH) Optic Fibre Communication Network, based on open standards and fully conforming to the relevant ITU-T Recommendations.

5.3.2 The OFC System shall support voice, data and video signal transmission between various locations and modes of transmission shall include, but not be limited to:

(1) point-to-point;
(2) point-to-multipoint;
(3) drop-and-insert;
(4) cross-connect; and
(5) any other modes required for the implementation of the Subsystems.

5.3.3 Optical Fibre Cable Network

5.3.3.1 There shall be two separate optical fibre cable backbone networks namely First Network and Second Network. Each of these two networks shall be formed by two outdoor single mode optical fibre cables. The normal and protected routes of these networks shall be routed through different fibre cables with route diversity.

5.3.3.2 The First Network shall be formed by two optical fibre cables, preferably one laid along the up-track and the other laid along the down-track ensuring route diversity, from Deen Dayal Upadhyay to New Bhaupur and terminated on Optical Distribution Frames (ODFs) in TERs at Stations and New Bhaupur Station only. Further, this First Network shall be taken to OCC by laying two additional optical fibre cables with route diversity from New Manauri Station to Subedarganj Station of IR and splicing through with two optical fibre cables, being laid from Subedarganj (IR) to OCC and terminated on ODFs in TERs at OCC under Contract Package CP–104.

5.3.3.3 The Second Network shall be formed by two optical fibre cables, preferably one laid along the up-track and the other laid along the down-track ensuring route diversity, from Deen Dayal Upadhyay to New Bhaupur and terminated on ODFs in TERs at Stations, New Bhaupur Station, Auto Location Huts, Interfacing IR Stations, IR Control Centre, GSM-R Locations, TSSs, SPs, SSPs, IMDs, IMSDs, LC Gates, Staff Quarters and any other location as required. Locations of termination of optical fibre cables of Second Network can be clubbed based upon design of other Systems/Sub-systems under this Contract as well as under Contract Package CP–204, while meeting overall Telecommunication Requirements.

5.3.3.4 In addition to SDH Network, optical fibres shall also be used for Data Networking System (as stipulated in Chapter-6) and Signalling Systems (as required).

5.3.3.5 All the optical fibre cables shall have a minimum fibre count of 24 fibres At least 25% of fibres within each cable shall be reserved as spares for future use.

5.3.3.6 The optical fibre cables within Station/IMD/IMSD and along the track shall be laid along different routes to provide 100% route diversity.

5.3.3.7 At least 10 metres slack in each optical fibre cable at all equipment rooms shall be provided for future network modification before taking cables to ODFs.

5.3.3.8 All fibres of optical fibre cables, including the spare fibres, at ODF shall be either spliced through or spliced with optical pigtails or terminated at the optical patch panels. At least 10 meter optical fibre cable loop shall be provided for each cable inside a suitable underground chamber at all Optical Fibre Cables Jointing Locations. ODFs shall be provided in the TERs at all the locations.

5.3.3.9 Optical Fibre Cable shall also be laid from SER/TER of Stations/Auto Location Hut to Field Units/Track Devices of Track Vacancy Detection System, as required, to meet the requirements of Particular Specifications-Signalling Works.

5.3.3.10 Optical fibre cables shall be supplied as per RDSO specification no. IRS: TC 55- 2006 (latest amendment) from RDSO approved sources only.

5.3.4 SDH Network

5.3.4.1 The SDH Nodes shall consist of STM Multiplexers with Optical Line Terminals connected to optical fibre cable backbone networks to form the SDH Network of the OFC System. The SDH Network shall provide dual and self-healing protected transmission paths.

5.3.4.2 The First Network shall carry all Voice & Data Communication between OCC and Stations. The First Network shall also carry all Train Management System information and other Vital & Safety Related Information between OCC and Stations. All Vital & Safety Related System using OFC System shall be implemented as per EN-50159.

5.3.4.3 The Second Network shall carry all Voice (including Emergency Communication) and Data (including Traction Power SCADA, Auxiliary SCADA) Communication between Stations and Auto Location Huts, LC Gates, Interfacing IR Stations, GSM-R Locations, TSSs, SPs, SSPs, IMDs, IMSDs, Staff Quarters and any other location, if required.

The Second Network shall also carry all Signal Control Information, Track Vacancy Detection Information and other Vital & Safety Related Information between Stations New Bhaupur Station, Auto Location Huts, LC Gates and Interfacing IR Stations. All Vital & Safety Related System using OFC System shall be implemented as per EN-50159.

5.3.4.4 Each SDH Node of the First Network shall be at least STM-16 level or higher in the SDH hierarchy. The exact level of SDH Node in SDH hierarchy shall be determined by the Contractor to meet the bandwidth requirements for sub-systems under this Contract as well as under Contract Package CP-204 with 50% Spare Capacity. SDH Node of First Network shall be equipped with minimum 2XSTM-16o and 4XSTM-4o Interfaces.

5.3.4.5 Each SDH node of the Second Network shall be at least STM-4 level or higher in the SDH hierarchy. The exact level of SDH Node in SDH hierarchy shall be determined by the Contractor to meet the bandwidth requirements for subsystems under this Contract as well as under Contract Package CP-204 with 50% Spare Capacity. SDH Node of Second Network shall be equipped with minimum 4XSTM-4o Interfaces.

5.3.4.6 SDH Nodes at Stations as well as at New Bhaupur Station shall be common for First Network & Second Network and equipped with Digital Cross Connect at VC3, VC4 and VC12 levels.

5.3.4.7 SDH Node at New Bhaupur Station shall be integrated with SDH Node being provided at New Bhaupur Station under Contract Package CP-104 using STM-16o interface with 1+1 Protection. Similarly SDH Node at OCC shall be integrated with SDH Node at OCC being provided under Contract Package CP-104 using STM-16o interface with 1+1 Protection.

With above integration, it shall be possible to make provisioning of VC4s and VC12s across SDH Nodes provided under this Contract as well as under Contract Package CP-104 to meet the requirement of various systems/subsystems under this Contract as well as under Contract Package CP-204.

5.3.4.8 SDH Traffic of New Bhaupur-New Khurja section shall be carried over to OCC using dedicated VC4s over First Network being provided under this Contract. This traffic shall be terminated at SDH Node at OCC is provided under Contract Package CP-104.

5.3.4.9 Control/Processor Card (if its failure results in affecting traffic), Switch/Matrix Unit & Power Supply Modules of SDH Equipment shall be provided with 1+1 Protection.

5.3.4.10 SDH Nodes at Deen Dayal Upadhyay and New Bhimsen shall be equipped with additional 2xSTM-16o interfaces for their future integration with SDH Network of Deen Dayal Upadhyay-Sonnagar and Khurja-Dadri section respectively.

5.3.4.11 SDH Equipments shall be equipped with Ethernet over SDH (EoS) as per ITU-T Rec. G.7041 at 10/100 BaseT. This Ethernet over SDH (EoS) shall facilitate delivery of Ethernet Private Line (EPL) Services, Ethernet Virtual Private Line (EVPL) Services and Ethernet Local Area Network (E-LAN) Services. The EoS shall support Layer-2 encapsulation and forwarding through Multiprotocol Label Switching (MPLS) using Ethernet Pseudo Wire (PWE3).

5.3.4.12 In order to realize the above mentioned services, there shall be in-built Layer-2 Bridging & Aggregation functionality as per IEEE 802.1d. There shall be support for VLAN Stacking (Q-in-Q) as per IEEE 802.1ad on all ports. The equipment shall support Ethernet Link OAM in

accordance with IEEE 802.3ah. The equipment shall also support Link Aggregation & Protection on service and trunk ports as per IEEE 802.3ad

5.3.5 Access Network

5.3.5.1 Each SDH Node shall support direct access of tributary signals including, but not be limited to:

- STM optical and electrical signals of same/lower levels;
- 2Mbps or the E1 tributaries;
- Ethernet tributaries at 10/100 BaseT;

5.3.5.2 The SDH Nodes shall be fully equipped minimum for 63(sixty three) 2 Mbps tributaries. All the tributaries shall be terminated on distribution frame for access.

5.3.5.3 Protection switching mechanisms shall be provided for the tributaries of the SDH Node. 2 Mbps tributaries shall be provided with 1:3 (Minimum) Protection and all the other tributaries shall be provided with 1+1 Protection.

5.3.5.4 The SDH Nodes of First Network shall be equipped with minimum 8 Ethernet 10/100 BaseT tributaries. SDH Nodes of Second Network (excluding at Stations) shall be equipped with minimum 4 Ethernet 10/100 Base T tributaries.

5.3.5.5 Flexible Access Multiplexers or Primary Order Multiplexer shall be provided with each and every SDH Nodes to connect to the 2Mbps tributaries of the SDH Nodes for direct access of channel circuits with data rate lower than 2Mbps.

5.3.5.6 Flexible Access Multiplexer or Primary Order Multiplexer shall have minimum 50% spares for all types of Channel Circuits (Minimum 1 for all types of Channel Circuits).

5.3.5.7 Channel circuits below 2Mbps level shall be divided among the Flexible Access Multiplexers for maximum diversity. All the channel circuits, including spare circuits, shall be terminated at the main distribution frame, digital distribution frame as appropriate for circuit access.

5.3.5.8 The OFC System shall provide Voice and Data Communication Network/Channels or Bandwidth to meet the requirement for system/subsystems being provided under this Contract as well as under Contract Package CP-204.

5.3.5.9 Ethernet Connections for each application need to be implemented through Ethernet Virtual Private Line Service.

5.3.5.10 The OFC System shall include a bandwidth management tool to ensure sufficient transmission capacity for each application to function under all traffic circumstances on the OFC System.

5.3.5.11 The OFC System shall provide Voice and Data Communication Network/Channels/Circuits or bandwidth for the following systems but not limited to:

(1) 2 Mbps E1 (ITU-T G.703 and G.823) Channels for the Telephone System;
(2) Other Data Circuits or Ethernet 10/100 Mbps Ports as required for Traction Power SCADA, Hot Axle Detection etc.
(3) Separate channel of 100 Mbps with redundancy for each of traction SCADA, Auxiliary SCADA for entire section under this Contract
(4) Other Data Circuits or Ethernet 10/100 Ports or 4W E&M Circuits or bare fibres for Vital & Safety Related Signal Control Circuits including Track Vacancy Detection.
(5) Sub 2 Mbps Voice Circuits for Direct Line Communication System, LC Gate Communication, Emergency Communication, Auto Signal Hut Communication and TSS/SP/SSP Communication.
(6) Other Data Circuits or Ethernet 10/100 Mbps Ports as required for TMS.

5.3.6 OFC System Network Synchronisation

5.3.6.1 The OFC System Synchronisation shall adopt master and slave synchronisation method.

5.3.6.2 The Network Element equipment shall support programmable prioritized synchronization source selection scheme covering all available synchronization sources.

5.3.6.3 The SDH Equipment shall derive the synchronisation timing signal from, but not limited to the following in order of priority;

- Master Clock Equipment/Sub Master Clock Equipment;
- an internal clock of the SDH Equipment;
- incoming STM Signal;
- incoming 2 Mbps Signal

5.3.6.4 The SDH Equipment shall switch automatically to another timing reference if the selected timing reference is lost under the criteria stipulated in ITU-T G.783.

5.3.6.5 The priority list and the synchronization source currently used by the equipment shall be retrievable.

5.3.6.6 The SDH equipment shall provide user-selection of synchronizing the outgoing STM signal in one of but not be limited to the following synchronization modes:

(1) Internal Clock Mode; and
(2) Incoming STM to outgoing STM Signals.

5.3.6.7 When all incoming timing reference is lost, the equipment shall be capable of entering into Holdover Mode.

5.3.6.8 Synchronization network shall be protected against single transmission network node/link failure, that is, a single node/link failure shall not cause a complete loss of synchronization reference to any other transmission network node.

5.3.6.9 Engineering of the synchronization network plan shall ensure the normal functional operation and no voice performance degradation of the inter-telephone switch communication.

5.3.6.10 Automatic re-configuration of synchronization source shall not cause any interruption or generation of errors in any low speed and high speed signals being transported by the Network Element equipment.

5.3.6.11 Synchronization plan shall prevent repeated switchovers of synchronization sources automatically when intermittent/frequent failures occur in the clock sources(s).

5.3.6.12 The Network Element equipment shall provide manual switchover to a specific synchronization source irrespective of its priority in synchronization sources selection with password protection. Manual switchover to a failed synchronization source shall be prevented by the equipment.

5.3.6.13 Facilities shall be provided at the Network Element equipment to monitor the performance of the derived synchronization timing signals and report the corresponding alarm conditions to the NMS.

5.3.7 Network Protection

5.3.7.1 The SDH Equipment shall support Protection Mechanism such as Linear Multiplex Section Protection, Sub Network Connection Protection (SNCP), Multiplex Section Shared Protection Ring (MSSP Ring).

5.3.7.2 Path Protection implementation through SNCP is preferred. SNC Protection shall be provided at VC-4, VC-3 and VC-12 level. Signal transmission shall be protected on a per path basis.

5.3.7.3 The normal and protected routes shall be routed through different Optical Fibre Cables with path diversity.

5.3.7.4 Automatic path protection switching shall occur upon detection of failure or alarm conditions which will affect the quality of signal transmission. The protection switching shall be completed within 50ms.

5.3.7.5 Manual Protection Switching facility shall be available. Manual Protection Switching shall be initiated by a switch command from the NMS. The protection switching shall be completed within 50ms.

5.3.7.6 Failure of any single SDH node shall not affect the operation of the remaining SDH nodes in the network. Fault in any single fibre cable section shall not affect the operation of any SDH node or Sub-systems data exchange. Alarm of the particular node shall be raised at the NMS.

5.3.7.7 The Flexible Access Multiplex Equipment shall be provided with 1+1 Redundancy for E1 Channels~~.~~ Further 1+1 Protection for Control (if its failure results in affecting traffic) & Power Supply Modules/Cards shall also be provided to ensure that a single failure shall not affect the availability of the ~~in~~ Flexible Access Multiplex Equipment.

5.3.7.8 No single failure shall affect the availability of OFC System or the Interfaces.

5.3.7.9 The OFC System, under the fault conditions, shall remain in operation and automatically reconfigure, if necessary, without the need for control by the NMS.

5.3.8 Service Telephone / Order Wire

5.3.8.1 A Service Telephone/Engineers Order Wire with handset shall be provided at each and every SDH Node locations for point-to-point and point-to-multipoint voice communication calls between maintenance staff at different SDH Node locations. It shall permit selective and group call functions.

5.3.8.2 The operation of Service Telephone/Engineers Order Wire shall not affect the operation of the signal transmission within the OFC System.

5.3.9 Network Management System

5.3.9.1 At the OCC, Network Management System (NMS) shall be provided to carry out Real-time centralised and remote monitoring and measurement of network status and performance, and the ability to take prompt action to control the flow of traffic when necessary. The equipment to be managed shall include SDH Equipment, Flexible Access Multiplexer/Primary Order Multiplexers, Optical Line Terminals etc.

5.3.9.2 NMS Workstation(s) shall be installed at the OCC in TER (or any other location as decided by the Engineer) for the operation of the NMS.

5.3.9.3 The NMS shall be equipped with spare ports for future additional Workstations and the ports shall allow remote connection through commercially available modems.

5.3.9.4 NMS Workstation(s) shall be equipped with a log printer for alarm and event print-out.

5.3.9.5 The NMS shall be equipped with mass storage device for storage of the configuration and alarm data-files.

5.3.9.6 The mass storage device shall provide facilities for downloading the configuration and alarm data files to CD/DVD/Pen Drive.

5.3.9.7 Laptop (Latest Version) Portable Service Terminals (4 numbers) loaded with Network Management Software shall also be provided for maintenance access to the network elements at various node locations.

5.3.9.8 The NMS shall have an internal clock synchronised to the Master Clock for the time and date information. The internal clock shall allow free running in case of loss of signal from master clock.

5.3.9.9 The NMS shall provide Operations, Administration, Maintenance & Provisioning (OAM&P) functions in accordance with the Telecommunications Management Network (TMN) concept described in ITU-T Recommendations M-3010.

5.3.9.10 **Alarm and Status Monitoring**

(1) The operational status and performance of all the network elements shall be monitored on a real time basis by the NMS. The status monitoring shall be down to the card level as a minimum.

(2) The network elements shall have alarm logging facilities so that detailed history of the failure alarms can be retrieved either locally using the portable service terminal or remotely by the NMS.

(3) Alarms to be collected from network elements shall include, but not be limited to, the following:

(a) loss of frame alignment;
(b) high error rate alarm;
(c) loss of pointer;
(d) loss of synchronisation;
(e) out of frame alignment;
(f) alarm indication;
(g) high/low optical power;
(h) high laser bias;
(i) tributary unit failure;
(j) power unit failure;
(k) external synchronisation failure; and
(l) any card/module failure.

(m) Main Power Failure;

(n) Input Failure;

(4) Failure alarms shall be classified into user configurable major/ minor etc. alarms. All alarms and status changes shall be stored in local storage of network elements, stored in mass storage device at OCC and output to the printer on demand. All alarms and status shall be stamped with time and date within an accuracy of 1 second.

(5) Each alarm log shall include details on the type and nature of the fault, alarm category, fault location, date and time fault is detected and date and time the fault is cleared. An audible alarm shall be given at NMS workstation and shall be reset by maintenance staff on acknowledgement.

(6) A local alarm indication for the network element shall be given and shall be reset automatically upon the alarm is cleared.

(7) A summary alarm shall be provided at the rack top to indicate the alarm status of any element within the rack. The summary alarm shall be reset automatically upon the alarm is cleared.

(8) The NMS shall provide function for user to enable and disable output of alarm events to the log printer.

5.3.9.11 **Performance Monitoring**

(1) The NMS shall calculate, display and provide print-out of the performance statistics for the SDH System.

(2) In-service performance monitoring for all network elements shall include, but not be limited to the following performance parameters:

(a) optical power transmitted;

(b) optical power received;
(c) degraded duration in minutes;
(d) severely error seconds;
(e) protection switching counts;
(f) protection switching duration;
(g) error seconds of the received E1 and above signals; signal level of the received E1 and above signals;
(h) error free seconds of the received E1 and above signals; and
(i) Bit error rate of the received E1 and above signals.
(j) Laser bias current

(3) Loss of power shall not cause any corruption or loss of data in the network elements and the NMS.

(4) The in-service performance data files shall be able to be transferred to disk or any other storage media subject to review by the Engineer. The data files shall be in format to allow analysis using commercially available software.

5.3.9.12 **Network Configuration and Provisioning**

(1) The Contractor shall provide a main and standby database for storing the system hardware and software configurations. Both the working and backup configuration data base shall be automatically and simultaneously updated for any changes in the data base.

(2) The NMS shall allow the user to configure all existing and new circuits with the following functions:

(a) interface port allocation;
(b) low speed (64 kbps & lower) interface cards configuration;
(c) lower order multiplex time slot allocation and routing;
(d) higher order multiplex/cross-connect switch configuration;
(e) logging of circuit routing data logged into configuration database;
(f) operator's configuration checks function prior to main and backup database update; and
(g) the OFC links from junction stations to the adjacent station of IR
(h) Frame Position Allocation;

5.3.9.13 **User Interfaces**

NMS functions shall be performed via a user-friendly graphical user interface (GUI) in real-time mode.

5.3.9.14 The Contractor shall be responsible for carrying NMS Traffic of OFC Network of New Bhaupur-New Khurja section being provided under Contract Package 104, from New Bhaupur Station to OCC for Termination at NMS provided under Contract Package 104. The design for above implementation shall be submitted to Engineer for approval before implementation.

5.4 Performance Specification

5.4.1 General

5.4.1.1 In addition to what has been specified in Chapter 3 the following performance requirements for the OFC System shall be complied.

5.4.1.2 The OFC System shall be equipped with sufficient capacities and margins such that the System can operate properly under peak load or traffic conditions.

5.4.1.3 Fault tolerant design with protections against failure shall be provided in order to achieve the system availability. Protections shall include, but not be limited to path diversity, redundancy and duplication of reliability critical equipment, component and circuits.

5.4.2 Reliability

5.4.2.1 The inability to perform any required function, the occurrence of unexpected action or the degradation of performance below the specifications shall be considered as a failure.

5.4.2.2 The Contractor shall furnish for the following sub-systems/equipment, the reliability figures, MTBF Hours from the OEMs.

(1) SDH Node Equipment
(2) Flexible Access Multiplexer or Primary Order Multiplexer
(3) Network Management System
(4) Wide Area Network & Local Area Network;

5.4.3 Availability Requirements

5.4.3.1 The Contractor shall implement a RAMS Plan defined in accordance with IEC 62278. Any degraded mode of operation or re-configuration functions provided by the OFC System shall not be included in the determination of the system availability. The Contractor shall submit to the Engineer for review and consent the RAMS analysis for the OFC System to establish the requirements of availability specified here below.

5.4.3.2 The availability of OFC System at circuit level shall be defined as the availability of the circuit between both end points of the Optical Fibre Communication System Network where the required bandwidth is available for access. The equipment connected for the access for the circuit bandwidth shall be excluded from the availability calculation.

5.4.3.3 Any circuit of the OFC System shall be considered unavailable if;

(1) there is a loss of communication between end points of the circuit; or
(2) Quality of the signal transmission within the circuit is below the performance standards stipulated in this Particular Specification.

5.4.3.4 The availability of any circuit at 2 Mbps level or higher within OFC system shall be better than 99.999%.

5.4.3.5 The availability of any circuits below 2 Mbps level shall be better than 99.995%.

5.4.3.6 The Network Management System shall be considered unavailable if any functions provided by the Network Management System cannot be properly exercised. The availability of the Network Management System shall be better than 99.5%.

5.4.4 Maintainability Requirements

5.4.4.1 The Contractor shall comply with the maintainability requirements as specified in Clause 3.4.

5.4.4.2 The service life of the OFC System (equipment) shall not be less than 15 years. Service life of all types of cables shall not be less than 25 years.

5.4.5 System Safety Requirements

5.4.5.1 In the event of a break in the optical fibre cable, the optical transmitter laser output shall shut down to a safe level as defined by IEC-60825, ITUT-G 958. The shutdown mechanism shall not be software dependent.

5.4.5.2 All equipment must comply with, and be installed in conformance with IEC 60065 and IEC 60364 or equivalent National Electric Code/Uniform Building Code of safety standards.

5.4.5.3 All metallic enclosures shall be provided with an earth terminal.

5.5 Technical Requirements

5.5.1 General

5.5.1.1 The Contractor shall submit the following information to the Engineer for review:

(1) details on the specifications of each low speed data and voice channel interfaces below E1 level;
(2) details on all the available data and voice channel interfaces that the Flexible/Primary Order Access Multiplexer can be equipped with and, the limitations;
(3) details on the hardware modularity of each type of data and voice interface including the incremental number of interfaces that can be added to a partially equipped equipment shelf and limitations on the addition of the interfaces to the equipment already equipped with mixed types of interfaces shall be defined;
(4) details on the electrical and physical specifications of the local maintenance port which support remote and local operation, administration, maintenance and provisioning (OAM&P) functions of the equipment;
(5) the calculations of delay for signal transmission between SDH nodes;
(6) optical link budget calculations for all the transmission links;
(7) a list of alarms for which the faults shall be detected;
(8) format in which alarms shall be displayed and remotely accessed for printing and display;
(9) the details on the maximum number of tributary signal interfaces that can be supported by the SDH node and the limitations;
(10) the details of the synchronisation network design and a synchronisation plan which describes the fall back arrangement, failure and restore criteria used to determine the switchover of synchronisation sources, the associated timings under each failure and restoration event and the method used in preventing repeated switchovers of synchronisation sources automatically when intermittent/frequent failure occur in the clock sources;
(11) the details of the NMS design, flow of management traffic and protection against SDH node failures or cable failures;
(12) types and maximum number of transmission equipment supported by the NMS;
(13) self-healing mechanism, normal traffic flow diagrams, protected traffic flow details for various single and multiple cable(s) and/or node(s) failures; and
(14) normal and protected bandwidth allocation, maximum traffic capacity and method of calculation for the SDH Network.

5.5.1.2 The Contractor shall estimate and provide the bandwidth needed in order to guarantee the level of service required by all the Sub-systems.

5.5.1.3 At least 50% Spare Traffic Bandwidth and capacity between nodes shall be provided for SDH Network and Primary Multiplexer Network. Spare capacity shall be achieved by providing additional cards and/or modules.

5.5.2 Technical System Performance

5.5.2.1 The OFC System shall conform to relevant ITU-T G-series Recommendation.

5.5.2.2 The jitter and wander performance shall conform to ITU-T Rec.G.823, G.825, G.783, and G.958 as applicable.

5.5.2.3 Voice Circuits shall have an end to end performance in accordance with ITU-T Rec. G.712.

5.5.2.4 Data circuits shall have an end to end error performance in accordance with the ITU-T Rec. G.821.

5.5.2.5 The maximum traffic interruption time for any required service bit rates due to link, node or any other failure shall be less than 50 ms. It shall include the duration for protection switch time completion with the sequence of events below.

(1) from the onset of a failure detection to the completion of protection switching;
(2) from the clearing of a failure to the completion of protection switching recovery (in case of reversion switching);
(3) from the activation of the recovery command to the completion of protection switching recovery (in case of non-reversion switching; and
(4) reframing time required by equipment including, but not be limited to, SDH equipment, flexible multiplexers, optical line terminal and data modem.

5.5.2.6 The absolute group delay, at the frequency of minimum group delay, shall not exceed the limit of 600 microseconds, as per ITU-T Recommendation, taking into account of the worst delay scenarios.

5.5.2.7 The system response times of the NMS shall be as follows:

(1) commands presented to the NMS from Management Workstation shall be processed and produce an appropriate output within 2 seconds maximum;
(2) real-time data presented to the Management Workstation from the network elements shall be processed and produce the appropriate output within 2 seconds maximum; and
(3) execution of parameter changes to SDH Nodes initiated through the NMS shall be less than 2 seconds.

5.5.3 Equipment Design Requirements

5.5.3.1 General

(1) The equipment design of OFC System shall be of standard rack with plug-in units. Hot swapping capability shall be provided for all cards/units including redundant power supplies. Hot-swapping of the plug-in units shall not affect the equipment operation.
(2) Equipment shall be equipped with protected test points for measurement and performance monitoring without affecting the traffic.
(3) Test access facilities shall be provided at different transmission levels.
(4) Equipment shall be provided with natural cooling arrangement, however if natural cooling arrangements are not adequate, the use of fan shall be provided.
(5) A summary alarm indication shall be provided at the top of each rack to indicate the summary alarm status of the equipment within the rack.

5.5.3.2 SDH Equipment

(1) All SDH equipment shall conform and be compliant with ETSI 300 147 and relevant ITU-T Recommendations including of G.707 to G.709, G.781, G.783, G.784 and G.957.
(2) The SDH Nodes at OCC, Stations and New Bhaupur Station shall provide cross connect capabilities with a granularity of VC4, VC-3 and VC-12. These Nodes shall have Non-Blocking Cross connect with minimum capacity of 64X64 VC4 equivalents at VC4 level and 32X32 VC4 equivalents at VC3 and VC12 level.
(3) Each SDH Node shall be equipped with (1+1) redundant configuration at optical and electrical levels at STM-16(if applicable) and STM-4 level.
(4) The SDH Equipment shall operate satisfactorily at 48V ± 20% DC. The Contractor shall provide power supply equipment for power conversion if necessary. The equipment shall be capable of withstanding voltage spikes of up to 3 Volts over the maximum voltage.

5.5.3.3 Flexible Access Multiplex Equipment

(1) Flexible Access Multiplex Equipment shall conform to ITU-T Rec. G.703, G.704, G.706, G.707, G.708, G.709, G.711, G.732, G.782 and G.823.
(2) Flexible Access Multiplex Equipment shall support Primary Multiplexing, Digital Branching and Digital Cross Connect. The granularity of Digital Cross Connect shall be N X 8 Kbits/Second.
(3) Flexible Access Multiplex Equipment shall support functionalities of Terminal Multiplexer, Protected Terminal Multiplexer, Drop/Insert Multiplexer, Bypass Multiplexer and Loop Protected Multiplexer.
(4) Flexible Access Multiplex Equipment shall support Omnibus Operation of Voice in digital format in Data Channels.

(5) Flexible Access Multiplex Equipment shall have in-built feature to provide details of performance data like AS, ES, SES, DM, etc. via NMS or via Laptop Service Terminal.

(6) Adequate numbers of Primary Multiplexers shall be provided so that there is no loss of Communication at any point of time.

(7) Flexible access multiplexer equipment shall be provided with 1+1 protection for all channel levels (VF, Data, etc.) with automatic switch over in case of fault.

(8) The optical line interfaces shall conform to ITU-T Rec. G.957.

(9) Flexible Access Multiplex Equipment shall operate satisfactorily at 48V ± 20% DC, The Contractor shall provide power supply equipment for power conversion if necessary. The equipment shall be capable of withstanding voltage spikes of up to 3 Volts over the maximum voltage.

(10) Channel Interfaces

(a) Where required, the Flexible Access Multiplex Equipment shall provide voice frequency interfaces for analogue telephone sets located not at the switch site, including but not be limited to the following, subject to the Review by the Engineer:

- voice interface selectable on two or four wires E&M signalling conforming to ITU-T Rec. G.712 respectively;
- voice interface microphone current feeding, subscriber loop signalling, on hook/off hook detection, ring trip and ringing current provision;
- Voice interface providing voice line connection to Extensions (FXS Interface) & PBX (FXO Interface); and
- any other voice interfaces required for other Subsystems/ designated contractors.

(b) The Contractor shall determine and provide appropriate types and quantities of channel interfaces based on the requirements of the Subsystems.

(c) The Contractor shall submit the details of all the channel interfaces which can be supported by the Flexible Access Multiplexer or The Primary Order Multiplexer.

(d) The voice interface shall be Pulse Code Modulated (PCM) in A-law as described in ITU-T Rec. G.711.

(e) The Flexible Access Multiplex Equipment shall provide, as required, data interfaces, including but not be limited to the following, subject to the review by Engineer:

- 0-19.2kbps synchronous or asynchronous data complying with ITU-T Rec. V.11 (EIA RS-422 or RS-485) interface etc.;
- asynchronous/synchronous full duplex data transmission complying with EIA/TIA-232-E and V.28 standard;
- 64 kbps synchronous data interfaces complying with ITU-T Rec. G.703 unbalance interface;
- nx64 kbps synchronous data interfaces complying with ITU-T Rec. V.11 and V.35 interface;
- ISDN Basic Rate Interface with 2B+D channels as defined in ITU-T Rec. I.430;
- Primary Rate Interface complying with ITU-T Rec. I.431 interface at 2.048 Mbps (30B+D); and
- Any other data interfaces required for other Subsystems.

5.5.3.4 Network Management System

(1) The NMS shall provide Operations, Administration, Maintenance & Provisioning (OAM&P) functions in accordance with the Telecommunications Management Network (TMN) concept described in ITU-T Recommendations M-3010.

(2) The NMS shall have provision to monitor network performance in accordance with ITU-T Rec. G.831.

(3) The NMS shall be equipped with a proven real-time, multi-tasking operating system to support centralised network management of the OFC equipment including both the SDH and PDH equipment from OCC.
(4) The operating system shall conform to ITU-T Rec. G.774 SDH informational model in managing the equipment. The operating system shall provide a versatile environment with automatic boot strap function for re-initialisation after a power interruption.
(5) The NMS shall support Q Interface conforming to ITU-T Rec.G.732, G.733 Q.811 & Q.812, Qecc. Interface as per ITU-T Rec.G.784 and F interface of V.24/V.28 type.
(6) Each Management Terminal shall be equipped with 24 inch colour LED backlit VDU to provide graphical representation and display of the network. A log printer shall be provided.
(7) The mass storage device shall provide storage capacity for at least one month configuration and alarm data.
(8) Each portable service terminal shall be powered by an internal rechargeable battery with more than 4 hours normal continuous time without recharging.

5.5.3.5 Cabling and Accessories

(1) Optical fibre cables shall be supplied as per RDSO specification no. IRS: TC 55- 2006 with Latest Amendments from RDSO approved sources.
(2) The Optical Fibre Connectors shall comply with IEC 60793 and IEC 60874.
(3) The requirements on cabling accessories, digital distribution frames, optical distribution frames, main distribution frames are as given in Chapter-14 of this Particular Specification.

5.5.4 System Expansion

5.5.4.1 The OFC System shall be equipped with sufficient capacities and margins such that the System can operate properly under peak load or traffic conditions.

5.5.4.2 It shall be possible to insert additional SDH Nodes into the OFC Network without affecting the performance of the Network, limits on this, if any, shall be specified by the Contractor for review by the Engineer.

5.5.4.3 The OFC System shall be compatible with SDH Equipment from other manufacturers.

5.5.4.4 The NMS for OFC System shall be designed and equipped with all necessary hardware, software and capacity for future additional SDH Equipment and associated Flexible Access Multiplexers and Channel Interfaces.

∗ End of Chapter 5 ∗

CHAPTER 6 - DATA NETWORKING SYSTEM

6.1 General

6.1.1 An extensive Data Networking System shall be provided for meeting the Packet Data Communications requirements of EDFC Phase-2. Data Networking System which is a Wide Area Network (WAN), shall, inter-alia, cover OCC, Stations, New Bhaupur Station, TSSs, IMDs, and IMSDs.

6.1.2 The Wide Area Network (WAN) shall provide sufficient bandwidth to cater for the Packet Data Communications requirements of various Sub-systems under this Contract as well as under Contract Package CP-204. This Wide Area Network (WAN) shall also provide sufficient bandwidth to cater for the Packet Data Communications requirements of EDFC Phase-2 for other applications such as Freight Operation Information System (FOIS), Crew Management System (CMS) and Wagon Management System (WMS).

6.1.3 All Vital & Safety Related System using Data Networking System shall be implemented as per EN-50159.

6.1.4 Wide Area Network (WAN) shall be a highly reliable system since it shall be the primary means of Packet Data Communications between various locations mentioned above. The System Design shall be highly resilient to Common Mode Failure with least recovery time and shall provide High Performance under normal operation as well as under worst case Network Loading.

6.1.5 Wide Area Network (WAN) shall be created using Layer-3 Switches and Optic Fibre Cable Networks of EDFC Phase-2.

6.1.6 WAN shall comply with internationally recognised Industry Standards & Open System Protocols. The Design of Wide Area Network (WAN) shall provide a highly Secure System, which shall prevent unauthorised Access and/or Hostile Intrusion.

6.1.7 Ethernet Services such as Ethernet Private Line (EPL) Services, Ethernet Virtual Private Line (EVPL) Services and Ethernet Local Area Network (E-LAN) shall be extended to Auto Location Huts, GSM-R Locations, LC Gates, SPs & SSPs using EoS (Ethernet over SDH) of OFC System for meeting the requirements of other Sub-systems within this Contract as well as under Contract Package CP-204.

6.1.8 At Junction Stations & Crossing Stations, Wi-Fi Facility, compliant with IEEE 802.11g Standards shall be provided for WAN Connectivity to users (which also include drivers of passing trains) via Wireless Enabled Devices and Equipment. A minimum of 10 simultaneous users may use the Wi-Fi Connectivity at Stations. This Wi-Fi Facility shall as a minimum cover Station Buildings and EDFC Tracks up to 500 meters in both directions.

6.1.9 Network Management System for Data Networking System to be provided at OCC shall facilitate configuration, administration, monitoring and troubleshooting of the Data Networking System.

6.1.10 Structured Cabling for Data Networking System shall be within the scope of work under this Contract.

6.1.11 Wherever, existing equipment provided under Contract Packages CP-104, are upgraded/augmented to meet the requirements 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 PS.

6.2 Scope of Supply for Data Networking System

The scope of supply shall include, but not be limited to, the following:

(1) Layer-3 Switches;
(2) Layer-2 Switches;
(3) Wi-Fi Access Equipment;
(4) Distribution Frames;
(5) terminating and interconnecting equipment/panels including termination protection devices
(6) equipment cabinets, racks and cubicles;
(7) all type of cables and cords;
(8) all required connectors;
(9) installation materials;
(10) Network Management System;
(11) earthing and accessories including termination protection devices;
(12) Power supply and all other data cables, earthing and accessories including termination protection devices.
(13) Spares shall be supplied in accordance with the stipulations in GS and PS;
(14) Test Instruments and Tools

6.3 System Requirements

6.3.1 WAN shall be created using Layer-3 Switches equipped with minimum 4 Nos. 10GigE Fibre Ports for backbone interconnections. WAN shall connect OCC, Stations, New Bhaupur Station, IMDs and IMSDs, in Ring Topology using Optic Fibre Cable Cable laid along Up and Down Track of DFCCIL. Further WAN shall connect TSSs, SP,SSP,LC gate with nearest stations/Auto Location Huts in Redundant Linear Topology using Optic Fibre Cable. Locations of Layer-3 Switches can be clubbed based upon design of other Systems/Subsystems under this Contract as well as under Contract Package CP-204 while meeting overall Packet Data Communication Requirements.

6.3.2 Layer-3 Switches at New Bhaupur Station shall be integrated with Layer-3 Switches being provided at New Bhaupur Station under Contract Package CP-104 using 10GigE Fibre Ports with 1+1 Protection.

6.3.3 Layer-3 Switches at OCC shall be integrated with Layer-3 Switches at OCC being provided under contract Package CP-104 using 10GigE Fibre Ports with 1+1 Protection.

6.3.4 Each Layer-3 Switch Site shall employ, as necessary, Multi-layer Switching comprising a combination of Layer-2 Switching and Layer-3 Protocol Routing. Layer-2 Switch shall be deployed as per Site Requirements. Network Topology and Connectivity Plan shall be submitted as part of Design to the Engineer for approval.

6.3.5 Layer-3 Switch shall be provided in fully duplicated configuration at each site in (1+1) Hot-Standby Configuration.

6.3.6 Layer-3 Switches at New Mirzapur, New Sujatpur, New Bhimsen and Deen Dayal Upadhyay shall be equipped with additional 2 Nos. 10GigE Fibre Ports.

6.3.7 WAN shall be of highly Scalable Design, whilst maintaining Throughput, Quality of Service and Security.

6.3.8 Ethernet Services such as Ethernet Private Line (EPL) Services, Ethernet Virtual Private Line (EVPL) Services, Ethernet Local Area Network (E-LAN) Services, Layer2 Protocol Tunnelling (L2PT), Virtual Private Wire Service(VPWS) & Ethernet over MPLS (EoMPLS) shall be available on WAN.

6.3.9 Ethernet Services such as EPL, EVPL & E-LAN shall be extended to Auto Location Huts, GSM-R Locations, LC Gates, SPs & SSPs using EoS (Ethernet over SDH) of OFC System.

6.3.10 EPL, EVPL, E-LAN, L2PT and VPWS Services of EDFC Phase-1 which are to be carried to OCC, shall be carried to OCC using QinQ. EPL, EVPL, E-LAN, L2PT and VPWS Services which are required to be provided across EDFC Phase-1 & EDFC Phase-2 shall be implemented by the Contractor.

6.3.11 Layer-3 Services such as IPv4 Routing, IPv6 Routing, Border Gateway Protocol (BGP), Intermediate System-to-Intermediate System (IS-IS), Open Shortest Path First (OSPF), Virtual Router Redundancy Protocol (VRRP)], Multi-Protocol Label Switching, Label Distribution Protocol (LDP), Targeted LDP(T-LDP), Primary & Secondary Label Switched Paths, MPLS L3 VPN, Resource Reservation Protocol (RSVP), MPLS Traffic Engineering (including TE-FRR), Pseudo wire LSP Load Sharing, Routed Pseudo wire, IP-VPN (RFC 2547/4364) and Integrated Routing & Bridging shall be available on the WAN. These services shall be implemented to cater for the communication requirements of various Sub-systems under this Contract as well as under Contract Package CP-204.

6.3.12 Layer-3 Services of EDFC Phase-1 which are to be carried to OCC, shall be implemented over WAN being provided under this Contract by Contractor

6.3.13 Layer-3 Services IPv4 Routing, IPv6 Routing, BGP, IS-IS, OSPF, VRRP, MPLS, LDP, T-LDP, Primary & Secondary Label Switched Paths, MPLS L3 VPN, RSVP, MPLS Traffic Engineering (including TE-FRR), Routed Pseudowire, IP-VPN (RFC 2547) and Integrated Routing & Bridging which are required to be provided across EDFC Phase-1 & EDFC Phase-2 shall be implemented by the Contractor.

6.3.14 Quality of Service (QoS) features such as Ingress & Egress Marking, Ingress & Egress Policing, Priority Queuing, Class-Based Queuing, WRED, Scheduling and Access Control List shall be available on the WAN..

6.3.15 Multicast protocols such as Internet Group Management Protocol (IGMP)/Protocol Independent Multicast (PIM) and (Multicast Source Discovery Protocol) MSDP shall be available on the WAN.

6.3.16 Wide Area Network (WAN) should support IPv4 and IPv6 Protocols. It shall support Static as well as Dynamic Host Configuration Protocol (DHCP) based IP Address Management.

6.3.17 Security features such as Authentication, Authorization & Accounting (AAA), Secure Shell Protocol (SSH), MAC Limiting per Ethernet Flow-point, Unicast/ Multicast/ Broadcast Storm Control Blocking, Layer-2 ACL, Layer-3 ACLs for IPv4 & IPv6 and DHCP Snooping shall be available on the WAN.

6.3.18 Operations, Administration & Maintenance features such as CFM OAM (IEEE 802.1ag), EFM OAM (IEEE802.3ah), MPLS OAM and OAM Functions & Features as per ITU-T Y.1731 shall be available on WAN.

6.3.19 Network Management System shall be provided for WAN. This Graphic User Interface(GUI) based NMS shall have a complete Data Network, so as to provide the necessary control, supervision, maintenance, configuration and performance management. This NMS shall support Layer-2 & Layer-3 Services. This NMS should support following minimum features:

(1) Fault Management & Analysis;
(2) GUI & Service Template based Configuration & Provisioning;
(3) Composite L2/L3 Service Creation & Management;
(4) Performance Statistics collection and management;
(5) Security Management;
(6) OAM Testing;
(7) Troubleshooting and Assurance;
(8) Historical and real-time path monitoring;
(9) Path computation for Network Planning/Traffic Engineering tool integration.

6.4 Performance Requirement

6.4.1 **General**

Performance requirements for Data Networking System shall be fully complied. This shall be based on fault tolerant design with protections against failure in order to achieve the system availability.

6.4.2 **Reliability**

6.4.2.1 The inability to perform any required function, the occurrence of unexpected action or the degradation of performance below the specifications shall be considered as a failure.

6.4.2.2 The Contractor shall furnish for the Layer-3 Switch and Layer-2 Switch, the reliability figures such as MTBF in years from the OEMs.

6.4.3 **Availability Requirements**

6.4.3.1 The Contractor shall implement a RAMS Plan defined in accordance with IEC 62278. Any degraded mode of operation or re-configuration functions provided by the Data Networking System shall not be included in the determination of the system availability. Contractor shall submit to the Engineer for review and consent the RAMS analysis for the Data Networking System to establish the requirements of availability specified here below.

6.4.3.2 The availability of Data Networking System shall be defined as the availability of the bandwidth between end points of the Data Networking System. The equipment connected for the access for the bandwidth shall be excluded from the availability calculation. The availability Data Networking System shall be better than 99.999%.

6.4.3.3 To improve the availability of Data Networking System various measure such as Resilient Ethernet Protocol, Pseudo wire Redundancy, Link Aggregation (IEEE 802.3ad) on Network/Access Ports, Rapid Spanning Tree Protocol (IEEE 802.1w), Multiple Spanning Tree Protocol (IEEE 802.1s), MPLS-TE Fast Reroute etc. as required shall be implemented.

6.4.3.4 The Network Management System shall be considered unavailable if any functions provided by the Network Management System cannot be properly exercised. The availability of the Network Management System shall be better than 99.5%.

6.4.4 **Maintainability Requirements**

6.4.4.1 The Contractor shall comply with the maintainability requirements as specified in Clause 3.4 of this document.

6.4.4.2 The service life of the Data Networking System (equipment) shall not be less than 15 years.

6.4.5 **System Safety Requirements**

6.4.5.1 In the event of a break in the optical fibre cable, the optical transmitter laser output shall shut down to a safe level as defined by IEC60825, ITU-T G.783, ITU-T G.798. The shutdown mechanism shall not be software dependent.

6.4.5.2 All equipment must comply with, and be installed in conformance with IEC 60065 and IEC 60364 or equivalent National Electric Code/Uniform Building Code of safety standards.

6.4.5.3 Switch shall conform to IEC 60950-1 Standards for safety requirements of IT Equipment.

6.4.5.4 All metallic enclosures shall be provided with an earth terminal

6.5 Technical Requirements

6.5.1 Layer-3 Switches of WAN should meet following minimum technical requirements:

6.5.1.1 Layer-3 Switches of WAN shall have 20 Nos. 10/100/1000 Base-T Auto Sensing Ports with RJ 45 Connectors, 4 Nos. 100/1000 Base-X ports for SFP complying with IEEE 802.3, IEEE 803.3u and 802.3ab standard, and 4 No's of 10G BaseX ports supporting Half Duplex, Full

duplex and Auto-Negotiation on each port to optimize bandwidth. 30 % spare ports of each type on layer-3 Switch shall be kept for future use.

6.5.1.2 Layer-3 Switches shall have minimum of 128 Gbps forwarding bandwidth at Layer-2 and Layer-3 Switching Fabric, a minimum of 32000 MAC address space and 95 million packets (64 Byte packets) per second forwarding rate.

6.5.1.3 Layer-3 Switches shall be capable of working with DC Power Supply with range of -40 to -54V. Power Supply Module shall be redundant field replicable in the switch.

6.5.1.4 All the Layer-3 Switches shall be mounted on a 19-Inch Rack. All accessories required for this mounting shall be supplied by the Contractor.

6.5.1.5 All Software/Hardware/License supplied along with the Layer-3 Switches shall be supplied to the Engineer.

6.5.1.6 Layer-3 Switches shall support features such as Link Aggregation Control (as per IEEE 802.3ad), VLAN on all Ports (IEEE 802.1Q), VLAN Tagging(IEEE 802.1q), Minimum 256 VLANs, Port-Based Authentication(IEEE 802.1x), Spanning Tree Protocol(IEEE 802.1d), Multiple Spanning Tree Protocol(IEEE 802.1s), Rapid Spanning Tree Protocol(IEEE 802.1w), ITU-T G.8032v2, Dynamic Host Configuration Protocol (DHCP), Inter VLAN IP Routing for Layer–3 Routing, IPv6 Routing, Strict Priority Queuing, RADIUS Protocol for console access restriction and authentication as per RFC 2138 and Basic IP Unicast Routing Protocols.

6.5.1.7 Layer-3 Switches shall support multiple privilege level to provide different level of access on console port and telnet sessions.

6.5.1.8 Switches shall support Online Software Reconfiguration to implement changes without rebooting.

6.5.1.9 Layer-3 Switches shall have console port with a RS-232/RJ-45 Interface for configuration and diagnostics purposes.

6.5.1.10 Layer-3 Switches shall support Telnet, SNMP (Simple Network Management Protocol) V1/V2/V3, Network Time Protocol, SSH (Secure Shell) V1/V2 and FTP (File Transfer Protocol).

(1) Timing and Synchronization - ITU-T Sync-E with stratum-3 system clock or IEEE 1588v2 Precision Time Protocol (Slave, Boundary & Transparent clock)
(2) Layer 3 switch should support visibility and flow export with IETF IPFIX format i.e. IPFIX, Net flow v9 etc.

6.5.2 Layer -3 Switch at OCC (Core Switch) shall meet the following minimum technical requirement in addition to the technical requirement mentioned above:

6.5.2.1 Layer-3 Switch (Minimum 2 nos.) at OCC shall have 48 Nos. 10/100/1000 Base-T/100/1000 Base-X Auto Sensing Ports with RJ 45 Connectors/SFP complying with IEEE 802.3, IEEE 803.3u and 802.3ab standard, and 4 No's of 10G BaseX ports supporting Half Duplex, Full duplex and Auto-Negotiation on each port to optimize bandwidth.

6.5.2.2 Layer-3 Switch at OCC shall be chaises based and should have redundant controller, redundant power supply and field replaceable fan trays.

6.5.2.3 30% spare ports of each type on layer-3 Switch at OCC shall be kept spare for future use.

6.5.3 Layer-2 Access Switches shall meet the following minimum technical requirements:

6.5.3.1 Layer-2 Switches of WAN shall have 24 Nos. 10/100 Base-T Auto Sensing Ports with RJ 45 Connectors, complying with IEEE 802.3, IEEE 803.3u and 802.3ab standard, supporting half duplex, full duplex and Auto-Negotiation on each port to optimize bandwidth.

6.5.3.2 Layer-2 Switches shall have minimum of 16 Gbps forwarding bandwidth at Layer-2 Switching Fabric, a minimum of 1,000 MAC address space and 6 million packets (64 Byte packets) per second forwarding rate.

6.5.3.3 Layer-2 Switches shall be capable of working with DC Power Supply with range of -40 to -54V. Power Supply Module shall be redundant and inbuilt/external in/to the switch.

6.5.3.4 All the Layer-2 Switches shall be mounted on a 19-Inch Rack. All accessories required for this mounting shall be supplied by the Contractor.

6.5.3.5 All Software/Hardware/License supplied along with the Layer-2 Switches shall be supplied to the Engineer.

6.5.3.6 Layer-2 Switches shall support features such as VLAN on all Ports (IEEE 802.1Q), VLAN Tagging (IEEE 802.1q) and Minimum 256 VLANs. It shall support centralized VLAN Management, so that VLANs created on the Layer-3 Switches shall be propagated to all other switches automatically.

6.5.3.7 Layer-2 Switches shall support features such as Link Aggregation Control (as per IEEE 802.3ad), Port-Based Authentication (IEEE 802.1x), Spanning Tree Protocol (IEEE 802.1d), Multiple Spanning Tree Protocol (IEEE 802.1s), Rapid Spanning Tree Protocol (IEEE 802.1w), ITU-T G.8032, Dynamic Host Configuration Protocol (DHCP), RADIUS Protocol for console access restriction and authentication as per RFC 2138 and Classification and Scheduling on all ports (IEEE 802.1p).

6.5.3.8 Layer-2 Switches shall Support multiple privilege level to provide different level to provide different level of access on console port and telnet sessions.

6.5.3.9 Switches shall support Online Software Reconfiguration to implement changes without rebooting. .

6.5.3.10 Layer-2 Switches shall support Telnet, SNMP (Simple Network Management Protocol) V1/V2/V3, Network Time Protocol, SSH (Secure Shell) V1/V2 and FTP (File Transfer Protocol).

6.5.3.11 Layer-2 Switches shall have console port with a RS-232/RJ45 Interface for configuration and diagnostics purposes.

6.5.3.12 30 % spare Ports on switches shall be kept spare for future use.

6.6 Security

6.6.1 Access Control Mechanisms shall be employed via Authentication, Authorization, and Cryptographic Key Validation, in accordance with IEEE 802.1X, to restrict WAN Access to Authorized Users only. Facilities shall be provided to ensure that the Confidentiality and Integrity of the Data Flows for the WAN cannot be compromised by, for example, Eavesdropping, or Interception and Content Modification.

6.6.2 WAN shall be protected against Malicious Activities on the Networks, including Attacks from Viruses, Denial of Services (DoS), Hacking, Hijacking, Spoofing and other Malicious Events that may compromise the Integrity of the Networks. Such Attacks shall include Sources within as well as outside the WAN.

6.6.3 Network Perimeter Firewall shall be provided to protect WAN against above Malicious Activities/Events from outside the WAN.

6.6.4 The Security Features for Connectivity and Access Control shall include Access Control Lists (ACLs), Authentication, Port-level Security and Identity-based Network Services.

6.6.5 It shall be possible to set individual Levels of Access Rights & Permissions for each User in order to control the Integrity of the Network itself and any Information contained in the Network.

6.6.6 The Contractor shall perform Security Analysis of WAN to demonstrate that all above Network Security Threats has been considered and mitigated.

6.6.7 A 'Global Security Plan' shall be recommended for the WAN including the Procedures to be adopted by the Employer and with the details of the Elements within that Plan.

6.6.8 The Contractor shall get its report on security analysis of data network examined from Cyber Security Expert/Agency approved by the Engineer. The suggestions/recommendations of this Cyber security Expert/agency shall be implemented by the Contractor.

6.6.9 Port Mirroring for Traffic Diagnostics shall be available.

6.7 Network Resilience and Protection

6.7.1 The Data Networking System shall include, to the extent necessary, the following facilities within the Core Elements of the Design to ensure the requisite Availability of Data Networking System:

(1) Redundant Hardware;
(2) Redundant Network Connections.
(3) Circuit Redundancy & Path Diversity;
(4) No Single Point of Failure.
(5) Recovery from Network Failures
(6) Hot-swap Capability.
(7) Facility for Upgrade of Software & Firmware without any loss of Service.

6.7.2 The WAN System shall remain in Operation and automatically re-configure, if necessary, without the need for Control by the Network Management System, under the fault conditions.

6.7.3 The WAN System shall provide suitable Mechanisms for graceful restart and also for graceful degradation, in which the System shall provide lessened utility or effectiveness in the presence of a Fault, but still manage to provide some Service.

6.8 Network Management System

6.8.1 The Contractor shall provide at each Site, the Local Access to Maintenance Staff to the necessary NMS Functions via a Laptop/Engineers Terminal, equipped with appropriate NMS Software.

6.8.2 Network Management System shall communicate with elements of WAN over SNMP (Simple Network Management Protocol) V1/V2/V3.

6.8.3 The Work Station for Network Management, at OCC, shall include a 24 inch colour VDU and high quality colour printing facilities for report generation.

6.9 Structured Cabling

6.9.1 All the Data Circuits from the Switches shall be terminated at the Patch Panel(s) inside the TER for distribution of the internal and external lines and interface with relevant Sub-systems and Project Contractors. All patch panels shall be equipped with proper cable management hardware for neat installation of the cables.

6.9.2 Standard RJ-45 modular socket shall be provided for termination of the Data Circuits for End Users via plug and socket arrangement.

6.9.3 CAT-6e cables shall be used for connection between Patch Panel(s) inside TER to the Standard RJ-45 modular socket

6.9.4 Short circuit and over voltage protection device shall be provided to protect circuits from faults occurring in all outdoor cables.

∗ End of Chapter 6 ∗

CHAPTER 7 - TELEPHONE SYSTEM

7.1 General

7.1.1 The Telephone System shall provide voice communications between locations equipped with telephone consoles/sets within the DFCCIL premises and other defined locations.

7.1.2 The Telephone System shall comprise of Administrative Telephone Network, Direct Line Telephone (DLT) Network, Control Communication System and Emergency Communication System.

7.1.3 Administrative Telephone Network and Direct Line Telephone Network shall be based upon Private Branch Exchange (PBX) for the operation, maintenance and administrative staff to set up voice communication.

7.1.4 Administrative Telephone Network and Direct Line Telephone Network shall be integrated with Administrative Telephone Network and Direct Line Telephone Network respectively provided under Contract Package CP-104 to meet the requirement of this Particular Specification.

7.1.5 Control Communication System shall be provided to meet omnibus voice communication requirement of Traffic Control between OCC and Stations.

7.1.6 Emergency Communication System shall provide an omnibus communication channel between OCC and all Automatic Signals.

7.1.7 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.

7.2 Scope of Supply

The Scope of Supply for the Telephone System shall include, but not be limited to the following:

(1) PBX Switches;
(2) IP Telephony Server;
(3) Media Gateways;
(4) Line and Trunk Interfaces;
(5) Direct Line Consoles;
(6) Telephone Sets;
(7) Voice Mail System;
(8) Telephone Network Management System;
(9) Voice Recording System;
(10) Control Communication Equipments;
(11) Emergency Communication Equipments;
(12) Power Supply Equipment, Cables and Accessories; and
(13) Distribution Frames, Cabinets, Enclosures, Racks, etc.

7.3 System Requirement

7.3.1 A highly reliable main and satellite PBXs based Telephone Network shall be installed and commissioned to provide TDM Communications Platform amongst telephone consoles/sets. Main PBX shall be provided at OCC, while Satellite PBXs shall be provided at all Stations. This Network of Main PBX and Satellite PBXs shall be created using 2 Mbps E1 Channels over SDH Network as covered in Chapter-5 of this Particular Specifications. If feasible

Contractor may upgrade/augment Main PBX provided at OCC under Contract Package CP-104 to meet the requirements of this Particular Specification

7.3.2 In addition to PBXs based TDM Telephone Network, IP Telephony Server (Call Server) shall be provided at OCC to provide VOIP based backup Telephony Communication Platform. Media Gateway shall be provided as required to meet the requirement of this Particular Specification. If feasible Contractor may upgrade/augment IP Telephony Server and Media Gateway provided at OCC under Contract Package CP-104 to meet the requirements of this Particular Specification.

7.3.3 The IP Telephony Server shall also have connections with each PBX over Wide Area Network (WAN) as covered in Chapter-6 of this Particular Specification. In case of failure of E1 link(s) between PBXs, all calls shall be routed via IP Telephony Server using IP Link(s) over WAN as an alternate route, without requirement of any manual intervention.

7.3.4 The PBXs shall have connection to the Public Switched Telephone Network (PSTN). This shall allow pre-selected extensions to access the PSTN or vice versa.

7.3.5 Administrative Telephone Network:

7.3.5.1 Administrative Telephone Network shall provide voice communication between OCC, Stations, Auto Location Huts, Interfacing IR Stations, GSM-R Locations, TSSs, SPs, SSPs, IMDs, IMSDs, Residential Quarters, Guest House and Club/Institute. Approximate requirements of Telephone Sets, which include Analogue Telephones as well as Digital Telephones, are as given in Table below:

SN	PBX Switch Location	Telephone Sets					
		Station Building	Nearby Residential Colonies	Nearby IMD or IMSD	Nearby Service Buildings	Nearby IR Stations	Total PBX Telephones*
1	Deen Dayal Upadhyay	20	5	10	10	10	55
2	New Ahraura Road	20	5	10	10	10	55
3	New Dagmagpur	20	5	10	10	0	45
4	New Mirjapur	20	5	10	10	0	45
5	New Unchdih	20	5	10	10	0	45
6	New Karchana	20	5	10	10	10	55
7	New Manauri	20	5	10	10	0	45
8	New Sujatpur	20	5	10	10	0	45
9	New Rasulabad	20	5	10	10	0	45
10	New Malwan	20	5	10	10	0	45
11	New Kanpur	20	5	10	10	10	55
12	New Bhimsen	20	5	10	10	10	55
13	OCC						32

*The requirement of Telephone Sets at individual location may vary. Exact requirement will be identified during Design Stage.

7.3.5.2 Administrative Telephones to be provided shall be Digital Telephones at OCC (16 Nos.) and at Stations (8 Nos. at each Station). All the remaining telephones shall be Analogue Telephones.

7.3.5.3 In addition to above, 2(Two) IP Video Phones shall be provided at OCC and 1(one) IP Video Phone shall be provided at each Station.

7.3.5.4 The telephones at Stations shall be directly terminated at PBXs, while telephones at locations other than Stations shall be either directly terminated at PBXs (if feasible) or connected to the nearest PBX via the OFC System.

7.3.5.5 The Contractor shall discuss with the Engineer to agree on the exact location of each Telephone Set and IP Video Phone.

7.3.5.6 The Administrative Telephone Network shall provide feature transparency across all the PBXs. The following PBX features shall be provided:

(1)	Automatic Call Back;	(2)	Busy Hunt;
(3)	Break-In;	(4)	Call Forward;
(5)	Call Park;	(6)	Call Party Name & Number Display;
(7)	Call Pickup;	(8)	Call Transfer;
(9)	Call Waiting;	(10)	Conference Call;
(11)	Hot Line;	(12)	Abbreviated Dialling;
(13)	Access Paging;	(14)	Attendant Recall;
(15)	Alternative Route Selection;	(16)	Last Number Redial;
(17)	Line Lockout;	(18)	Malicious Call Trace;
(19)	Recorded Announcement;	(20)	Direct Inward Dialling (DID);
(21)	Direct Outward Dialling	(22)	Distinctive Ringing;
(23)	Last Number Redial	(24)	Music on Hold;
(25)	Speed Dial;	(26)	Voice Mail; and
(27)	Forced Release.		

7.3.5.7 The assignment of the class of service and features to any telephone extension shall be configurable.

7.3.5.8 The Administrative Telephone Network shall support closed homogeneous numbering plan across the network such that the user has to just dial the extension number of the user, he wishes to reach from anywhere in the network. Further this numbering plan of EDFC Phase-2 shall also be homogenous with numbering scheme adopted for EDFC Phase-1 under Contract Package CP-104. The numbering plan shall be discussed with Engineer and implemented only after it is reviewed by Engineer.

7.3.5.9 The Administrative Telephone Network shall support a minimum of the following four levels of programmable restrictions to each telephone extension:

(1) totally restricted level in which user cannot make or receive calls to and from the PSTN through the telephone extension;
(2) semi-restricted level in which user cannot make PSTN calls but can receive PSTN calls through Direct Inward Dialling(DID);
(3) local level in which the telephone extension user can make or receive local PSTN calls only; and
(4) Unrestricted level in which there shall be no restriction on the telephone extension for call connection.

7.3.5.10 Analogue Telephone Sets to be provided for Administrative Telephone Network shall be equipped with following facilities:

(1) Handset;
(2) 12 Push-button DTMF Keypad;
(3) On-hook Dialling function;
(4) Display Unit showing Calling and Caller's extension number for Incoming and Outgoing Calls;
(5) 4 Feature Buttons for Redial, Hook-Flash, Mute and Hold;
(6) Hand-Free operation through built-in speaker and microphone; and
(7) Powered by the PBX.

7.3.5.11 Digital Telephone Sets to be provided for Administrative Telephone Network shall be equipped with following facilities:

(1) Handset;
(2) 12 Push-button DTMF keypad;
(3) On-hook Dialling function;

(4) Display Unit showing Calling and Caller's extension number for Incoming and Outgoing Calls;
(5) Ringing Signal Lamp;
(6) Voice Mail Message Lamp;
(7) Hand-Free operation through built-in speaker and microphone;
(8) Adjustable volume control for speaker and ringer;
(9) A minimum of 10 programmable function keys for flexible assignment for; system features or additional extension circuits
(10) Display of call duration;
(11) System Clock Display;
(12) A minimum of 20 Memories for speed dialling; and
(13) Powered by the PBX.

7.3.5.12 IP Video Phones to be provided for Administrative Telephone Network shall be equipped with following facilities:

(1) Handset
(2) On-hook Dialling function;
(3) Hand-Free operation through built-in speaker and microphone;
(4) Adjustable volume control for speaker and ringer;
(5) Display Unit showing Calling and Caller's extension number for Incoming and Outgoing Calls;
(6) Display of call duration;
(7) System Clock Display;
(8) Powered via POE Class 2/3
(9) Support for H.323/SIP
(10) 5" Screen or better for Video
(11) Picture-in-Picture Support;
(12) Integrated Camera with high quality video for video calling;
(13) Automatic low light correction;
(14) Video codec support ITU-T H.263/H.263+/H.264 as a minimum
(15) Video frame rate CIF 30 FPS or better;
(16) 2 RJ-45 10/100/1000BT Ethernet Port POE
(17) Supporting DHCP Client or Static IP Address Allocation Plan;
(18) RTCP and RTP Support;
(19) QoS Support and TOS Diffserv (IEEE 802 1p/q); and
(20) XML Support.

7.3.5.13 The Administrative Telephone Network shall have the capacity of ringing up to minimum of three telephone sets connected in parallel.

7.3.6 A Voice Mail System (VMS) shall be provided and integrated with the PBX Network to enable administrative telephone users to leave, retrieve and broadcast voice messages. Voice Mail shall only be provided to pre-selected groups of staff or telephones. If feasible Contractor may upgrade Voice Mail System (VMS) provided under Contract Package CP-104 to meet the requirements of this Particular Specification.

7.3.7 Direct Line Telephone Network

7.3.7.1 The Direct Line Telephone Network shall provide instant, non-blocking & uninterruptible communication between key strategic points, which shall include, but not be limited to:

(1) Train Traffic Control Communication: This is provided for communication with one-touch button selective calling facility between the Traffic Controller in the OCC and Station Controller (SC) at Stations, IR Sectional Control Centres along the DFC Route, Depot Control Rooms, Crew Control Rooms, and other important locations along the route as decided by Engineer, for the control of train movements and effective utilization of section capacity.

(2) Traction Power Control Communication: This is provided for communication with one-touch button selective calling facility between Traction Power Controller in the

OCC, Station Controller at Stations, Switching/Feeding Posts of Traction Power to the Overhead Alignment and Maintenance Staff Rooms at wayside locations.

(3) Engineering Control Communication: This is provided for communication with one-touch button selective calling facility between OCC and important Civil Engineering maintenance and work related locations along the track as decided by the Engineer.

(4) S&T Control Communication: This is provided for direct line communication with one-touch button selective calling facility between OCC and important S&T maintenance and work related locations along the track as decided by the Engineer.

(5) between adjacent Station Control Rooms for stations with one-touch button dialling;

(6) between Station Control Rooms of New Bhaupur Station and New Bhimsen stations;

(7) between Station of DFCC and Interfacing Station Master Room of Indian Railway with one-touch button dialling;

(8) between LC Gates and Station Control Rooms of adjacent stations with one-touch button dialling; and

(9) between Depot Control Rooms and Station Control Rooms of adjacent stations with one-touch button dialling.

7.3.7.2 The Direct Line Telephone Network shall be built using PBXs at OCC and Stations. However, PBXs shall have separate extension/line interface cards and separate trunk interface cards to make Direct Line Telephone Network more reliable and non-blocking.

7.3.7.3 Direct Line Network shall facilitate Group Call, Conference Call (with facilities to add additional users (minimum of 6 parties) to an established call) & Emergency Call (with priorities). Direct Line Network shall also facilitate priority level for each category of call.

7.3.7.4 The assignment of the class of service, priority level and features to any Direct Line Telephone extension shall be configurable.

7.3.7.5 Direct Line Console

(1) Direct Line Consoles shall be provided for Assistant Controller, Traffic Controller at OCC and shall have a minimum direct line capacity of 100 lines and shall be capable of interfacing with required direct line extension. The Contractor shall however determine the exact size of each Direct Line Console based on the direct line extensions to be terminated on each Console.

(2) Direct Lines Consoles provided under Contract Package CP-104 for Chief Controller, Deputy Chief Controller, Traction Power Controller, Signalling Fault Management Controller and Track Controller, having a minimum direct line capacity of 100 lines, shall be upgraded/reconfigured to meet the communication requirement mentioned in this Particular Specification, as these controllers are common for EDFC Phase-I and EDFC Phase-2.

(3) Direct Line Consoles shall be provided for Station Controllers in SCR of each Station and shall have a minimum direct line capacity of 30 lines and shall be capable of interfacing with required direct line extensions.

(4) Direct Line Console provided at New Bhaupur Station under Contract Package CP-104 shall be upgraded/reconfigured to meet the communication requirement mentioned in this Particular Specifications.

(5) The Direct Line Console shall be configured as a desktop model/flush mounted in a desk ergonomically matching with the control room furniture.

(6) The Direct Line Console shall provide selection facilities in the form of push button and/or soft keys with visual display unit for user to perform, but not be limited to, the following functions as a minimum:

(a) originate outgoing calls to the selected user;
(b) select and answer any incoming calls destined for the Direct Line Telephone Console;
(c) originate outgoing calls to a pre-defined group of users;
(d) originate outgoing calls to a group or all users defined by the Direct Line Telephone Console at the time before the call is placed;
(e) make conference calls to add additional users to an established call connection;
(f) patch calls or put through two individual users for call connection;
(g) transfer call to PBX extension; and
(h) make and receive emergency call (override facility).

(7) The Direct Line Console shall be equipped with, but not be limited to, the following facilities:

(a) handset;
(b) push button or soft key for each Direct Line Telephone;
(c) 12-push button keypad for dialling;
(d) adjustable volume control for speaker and ringer;
(e) hands-free operation through built-in speaker and microphone;
(f) powered by the Central communications processor;
(g) visual display of details for incoming and outgoing calls;
(h) display of call duration;
(i) system clock display;
(j) lamp for message waiting;
(k) lamp for ringing signal; and
(l) transmit DTMF signal when call has been connected.

(8) The Direct Line Communication System shall support a minimum of 8 simultaneous incoming calls to the Direct Line Console to be queued before these calls are answered. The identity of the calling parties in the queue shall be displayed on the Direct Line Console in ascending order of the incoming sequence. Console Controller shall be able to answer calls in queue in any sequence. Call answered shall be removed immediately from the display.

(9) The selection facilities of the Direct Line Console, in the form of physical push button and/or soft key, shall be labelled with identity of the called party or functions of the selection facilities.

(10) The selection facilities shall provide selection status indication in the form of LCD or LED displays.

(11) Dedicated push button and/or soft keys shall be assigned to each telephone line which can be connected to the Direct Line Telephone/Console.

(12) At least 10 spare push buttons and/or soft keys shall be provided for assignment of additional functions or Console/Telephone.

(13) The push buttons and/or soft keys of similar functions or nature shall be grouped together to facilitate the user to locate the required selection.

(14) The Direct Line Console shall also be provided with functions for operation as an ordinary telephone set. The Direct Line Console shall be equipped with keypad for dialling to originate administrative telephone network call and support on-hook dialling.

(15) The Direct Line Console shall give different audio and visual indication for normal and emergency calls.

7.3.7.6 Indian Railway Telephone Network shall be integrated with Direct Line Communication System, so that one touch dialling can be done from Direct Line Console to important Operation Locations of Indian Railway as decided by the Engineer.

7.3.7.7 Public Switch Telephone Network (PSTN) Lines shall also be integrated with Direct Line Communication System, so that one touch dialling can be done from Direct Line Console to Electric Power Companies, Emergency Services etc. as decided by the Engineer.

7.3.7.8 Direct Line Telephones

(1) Direct Line Telephone shall be provided in the other locations such as IR Sectional Control Centre, Interfacing Station Master Room of IR, LC Gates, Crew Control Rooms, Depot Control Rooms, Switching/Feeding Posts, TPC Maintenance Staff Rooms, Important Civil Engineering Maintenance & Work related Locations and Important S&T Maintenance & Work related Locations etc., to meet communication requirement as mentioned in Clause 7.3.7.1 above.

(2) These Direct Line Telephones shall have a minimum direct line capacity of 10 lines and shall be capable of interfacing with required direct line extensions. The Contractor shall however determine the exact size of such Direct Line Telephones during the design phase.

(3) Direct Line Telephones provided at SCR of New Bhaupur Station and any other location as required provided under Contract Package CP-104 shall be upgraded/reconfigured to meet the communication requirement mentioned in this Particular Specification.

(4) It shall be possible from Direct Line Telephone to make normal and emergency direct line calls to the designated controllers in OCC. Different audio and visual indications shall be provided for incoming direct line calls on the Direct Line Consoles or Direct Line Telephone for normal and emergency calls.

7.3.7.9 The Contractor shall set up the priority level for Direct Line Consoles/Telephones in consultation with the Engineer.

7.3.7.10 Direct Line Console shall have preset buttons such that by pressing one of these buttons shall immediately connect to the destination. On the opposite, when a telephone connected to a Direct Line Communication System is picked up, the corresponding button on the Controller's Console shall immediately flash together with the ringing tone

7.3.8 Integration of Telephone Networks

7.3.8.1 Administrative Telephone Network and DLT Network provided under this Contract shall be integrated with Administrative Telephone Network and DLT Network respectively provided under Contract Package CP-104 to meet the requirement of this Particular Specification.

7.3.8.2 After integration, Administrative Telephone Networks shall provide following feature transparency across all the PBXs provided under this Contract as well as under Contract Package CP-104:

(1)	Break-In;	(2)	Call Forward;
(3)	Call Park;	(4)	Call Party Name & Number Display;
(5)	Call Pickup;	(6)	Call Transfer;
(7)	Call Waiting;	(8)	Conference Call;
(9)	Hot Line;	(10)	Abbreviated Dialling;
(11)	Access Paging;	(12)	Attendant Recall;
(13)	Alternative Route Selection;	(14)	Last Number Redial;
(15)	Line Lockout;	(16)	Malicious Call Trace;
(17)	Recorded Announcement;	(18)	Direct Inward Dialling (DID);
(19)	Direct Outward Dialling	(20)	Distinctive Ringing;
(21)	Last Number Redial	(22)	Music on Hold;
(23)	Speed Dial; and	(24)	Voice Mail.

7.3.8.3 After integration functionality as mentioned in Clause 7.3.3 of this Particular Specification shall be available across Administrative Telephones provided under this Contract as well as under Contract Package CP-104.

7.3.8.4 After integration, it shall be possible to make IP Audio & Video calls across IP Video Phones provided under this Contract as well as under Contract Package CP-104.

7.3.8.5 After integration, Direct Line Telephone Network shall provide all functionality as mentioned in Clause 7.3.7 of this Particular Specification across all the Direct Line Consoles/Telephones provided under this Contract as well as under Contract Package CP-104.

7.3.8.6 For above integration, Contractor shall, either provide new PBX, Telephony Server, Media Gateway, Telephone NMS and other associated equipment at OCC and integrate these equipment with PBX, Telephony Servers, Telephone NMS and associated equipment provided at OCC under Contract Package CP-104; **or** upgrade the PBX, Telephony Server, Media Gateway, Telephone NMS and other associated equipment provided at OCC under Contract Package CP-104 to meet the requirement of this Particular Specification.

7.3.8.7 If integration is done by providing new PBX, Telephony Server, Media Gateway and associated equipment at OCC:

(1) PBX provided under this Contract shall be integrated with PBX provided under Contract Package CP-104, through minimum 4 PRI for Administrative Telephone Network and 4 PRI for DLT Network. PBX provided under Contract Package CP-104 shall be suitably upgraded for this integration.

(2) Telephony Server provided under this Contract shall be integrated with Telephony Server provided under Contract Package CP-104, through redundant Data Links allowing maximum simultaneous IP Voice Calls and IP Video Calls across EDFC Phase-I & EDFC Phase-2 as per capacity of Telephone Servers & Media Gateways provided under this Contract and under Contract Package CP-104. Telephony Server & Media Gateway provided under Contract Package CP-104 shall be suitably upgraded for this integration.

7.3.8.8 If integration is done by upgrading PBX, Telephony Servers, Telephone NMS and associated equipments provided at OCC under Contract Package CP-104:

(1) Spare PRI available at PBX provided under CP-104 shall not be utilized for meeting the requirements under this Contract.
(2) The Contractor shall be responsible and liable for upgraded PBX, Telephony Server, Media Gateway, Telephone NMS and other associated equipment during Defect Notification Period and during Service Life.

7.3.8.9 The following additional PRI over E1 Link between PBXs provided under this Contract as well as under Contract Package CP-104 shall be provided:

SN	Communication Link
1	New Ekdil- Deen Dayal Upadhyay
2	New Karchana—New Tundla
3	New Kanpur-New Khurja

The PBXs provided at New Ekdil, New Tundla and New Khurja under Contract Package CP-104 shall be upgraded/augmented and reconfigured for providing above PRI over E1 Link. Spare PRI available at PBXs provided at New Ekdil, New Tundla and New Khurja under Contract Package CP-104 shall not be utilized for meeting this requirement.

7.3.9 Voice Recording System (VRS)

7.3.9.1 A centralised Voice Recording System (VRS) shall be provided at OCC to record telephone conversations of all controllers in OCC and Stations. This includes conversation over Direct Line Telephone Network, Control Communication System and Emergency Communication System. A centralised Voice Recording System (VRS) is being provided at OCC, to record telephone conversations of all controllers at OCC and Stations of EDFC Phase-1, under Contract Package CP-104. If required, Contractor may upgrade/augment this VRS provided under Contract Package CP-104 to meet the requirements of this Particular Specifications.

7.3.10 Telephone Network Management System

7.3.10.1 A Network Management System with a workstation, system database, logging printers and mass storage devices shall be provided at the designated place as decided by the Engineer.

7.3.10.2 The Telephone Network Management System has been set up to provide control, supervision and maintenance functions for the Administrative Telephone Network and Direct Line Telephone Network. The following management and administrative functions shall be provided through the use of the centralized maintenance console:

(1) User Data Management;
(2) Fault Monitoring;
(3) Performance Management;
(4) Call Detail Recording;
(5) Voice Detail Recording;
(6) Configuration Management;
(7) Application Program Interface;
(8) Accounting Management;
(9) Maintenance History Management;
(10) System Diagnostics;
(11) Remote Access (RA);
(12) Data Logging;
(13) Remote Alarm Monitoring; and
(14) GUI based Network Topology View.

7.3.10.3 Access to the Telephone Network Management System shall be password protected.

7.3.10.4 Failure in the Telephone Network Management System shall not affect the normal operation of the TDM based PBX Telephony Network or VOIP based Telephony Network.

7.3.11 Control Communication System

7.3.11.1 Control Communication System shall be provided to meet omnibus voice communication requirement of Train Traffic Control.

7.3.11.2 This is provided for communication with one-touch button selective calling facility between the Traffic Controller in the OCC and Station Controller at Stations, IR Sectional Control Centres along the DFC Route, Depot Control Rooms, Crew Control Rooms, and other important locations along the route as decided by the Engineer.

7.3.11.3 Control Communication System shall be provided using Control Communication Equipment as per RDSO Specification No. RDSO/SPN/TC/66/2007. Control Communication System shall be procured from RDSO approved sources only

7.3.11.4 New system shall be provided for the integration of this section. If required, Contractor shall upgrade/augment/reconfigure Control Communication System provided under Contract Package CP-104 to meet the requirements of this Particular Specifications.

7.3.12 Emergency Communication System

7.3.12.1 Emergency Control Communication which is an omnibus communication channel terminating at OCC with the Traction Power Controller shall be provided. This Emergency Control Communication shall not have selective calling facility. Emergency Control Communication shall have Emergency Sockets as per IR Standards for RE Areas at all the Automatic Signals and Block sections in link Line to which this omnibus communication channel is terminated. The Portable Telephone of IR Standard for RE Areas, which will be carried by the crew, can be plugged in case of emergency. This Emergency Control Communication channel can be switched to the other controllers by the Traction Power Controller. For better availability, two emergency control communication channel shall be provided, one terminating on the signal posts of Up track and the second one terminating on the signal posts of Down track.

7.3.12.2 Emergency Control Communication up to Automatic Signals shall be extended using Underground Railway Jelly Filled Telecom Quad Cable as per RDSO Specification No. IRS:TC 30-05 with latest amendments.

7.3.12.3 Wherever feasible, Telecom Quad Cable provided for Signalling System under Particular Specification-Signalling Works, shall be utilized for Emergency Control Communication. However, in such cases separate Quad shall be utilized for Emergency Control Communication.

7.3.12.4 Contractor shall upgrade/augment Emergency Control Communication provided under Contract Package CP-104, if required

7.4 Performance Specification

7.4.1 General

7.4.1.1 In addition to what has been specified in Chapter 3 the following performance requirements for the telephone system shall be complied.

7.4.1.2 Fault tolerant design with protections against failure shall be provided in order to achieve the system availability. Protections shall include, but not be limited to path diversity, redundancy and duplication of reliability critical equipment, component and circuits.

7.4.2 Reliability

7.4.2.1 The inability to perform any required function, the occurrence of unexpected action or the degradation of performance below the specifications shall be considered as a failure.

7.4.2.2 The Contractor shall furnish for the following sub-systems/equipment, the reliability figures, MTBF Hours from the OEMs.

(1) Switching Module of the PBXs;
(2) Processor Module of the PBXs;
(3) Memory Module of the PBXs;
(4) Line and Trunk Interface Module of PBXs;
(5) Power Supply Module of PBXs;
(6) Telephony Server ;
(7) Media Gateway;
(8) Direct Line Consoles;
(9) Direct Line Telephones;
(10) Control Communication Equipment; and
(11) Emergency Control Communication Equipment.
(12) Telephone NMS Workstation;

7.4.3 Availability Requirements

7.4.3.1 The Contractor shall implement a RAMS Plan defined in accordance with IEC 62278. Any degraded mode of operation or re-configuration functions provided by the Telephone System shall not be included in the determination of the system availability.

7.4.3.2 The availability of the connection within Administrative Telephone Network shall be better than 99.99%.

7.4.3.3 The availability of the connection within Direct Line Telephone Network shall be better than 99.999%.

7.4.3.4 Voice Recording System, if provided in this phase, shall be considered unavailable under any one or combination of the following conditions:

(1) messages cannot be recorded into the Voice Recording System;
(2) messages cannot be retrieved from the Voice Recording System; and
(3) corruption of voice message stored in the Voice Recording System.

7.4.3.5 The availability of the Voice Recording System shall be better than 99.99%.

7.4.3.6 Telephone Network Management System shall be considered unavailable if any functions provided by the Telephone Network Management System cannot be properly exercised. The availability of the Telephone Network Management System shall be better than 99.95%.

7.4.3.7 The Voice Mail System shall be considered unavailable under any one or combination of the following conditions-

(1) Message cannot be recorded into the Voice Mail System when the voice mail box of the affected user is not full;
(2) Message cannot be retrieved by the user; and
(3) Corruption of voice message stored in the Voice Mail System

7.4.3.8 The availability of the Voice Mail System shall be better than 99.95%.

7.4.4 Maintainability Requirements

7.4.4.1 The Contractor shall comply with the maintainability requirements as specified in Clause 3.4.

7.4.4.2 The service life of the Telephone System (equipment) shall not be less than 15 years. Service life of all types of cables shall not be less than 25 years. Service life shall be counted from the commencement date of the Defects Notification Period.

7.4.5 System Safety Requirements

7.4.5.1 The Subsystem shall not present any safety hazard to the operation and maintenance persons.

7.4.5.2 All equipment must comply with, and be installed in conformance with IEC 60065, IEC 60364 or equivalent National Electric Code/Uniform Building Code of safety standards.

7.4.5.3 All metallic enclosures shall be provided with an earth terminal.

7.5 Technical Requirement

7.5.1 PBX Network

7.5.1.1 Administrative Telephone Network and Direct Line Telephone Network shall be based upon PBX Network, which shall conform to applicable ITU-T standards.

7.5.1.2 The PBX Network shall offer a fully integrated and transparent digital service acting as a single digital switch.

7.5.1.3 PBXs to be supplied, installed and commissioned for Administrative Telephone Network at stations shall be equipped to, as a minimum and not limited to, the following:

S.N	Description of Item	Stations	OCC
1	Equipped Ports	128	64

2	Wired Ports	224	128
3	Analogue Telephone Ports	96	32
4	Digital Telephones Ports	32	32
5	Ports for CO lines	4	8
6	Ports for DID lines	4	8

7.5.1.4 If a new PBX is not provided at OCC and PBX at OCC provided under Contract Package CP-104 is being upgraded/augmented , it shall be upgraded/augmented for a minimum 32 Analogue Telephone Ports and 32 Digital Telephone Ports and meet the requirements for Administrative Telephone Network to be provided under this Contract.

7.5.1.5 The PBXs shall be additionally equipped with Ports for Direct Line Telephone Network over and above the Equipped Ports mentioned in Clause 7.5.1(3 & 4) above.

7.5.1.6 The PBX Network shall provide non-blocking connection for extension calls within the same PBX.

7.5.1.7 For calls through trunks or tie lines, the Administrative Telephone Network shall provide a GOS of 1% for the following traffic intensity during an average busy hour under normal condition without traffic overflow:

(1) DID trunk traffic intensity at 1.5 HCS per extension;
(2) CO outgoing trunk traffic intensity at 1.5 HCS per extension;
(3) Traffic intensity of 18 HCS per digital extension;
(4) 25% of the station traffic intensity assumed to use tie lines; and
(5) Traffic intensity of 1.5 HCS per voice-mail system user assumed to use tie lines.

7.5.1.8 For calls through trunks or tie lines, Direct Line Telephone Network shall provide Grade of Service (GOS) of 0.1% during an average busy hour under normal condition without traffic overflow.

7.5.1.9 The extension line interface in the exchange equipment shall match the extension equipment as required and fulfil the following requirements :

(1) loop resistance of subscriber connected on physical cable pairs shall be limited to 1200Ω. The minimum value of the leakage resistance of the line shall be 20 K Ohms; and

(2) the exchange line shall block the extension line after certain period of “Off- Hook” condition without a selection being received. This period shall be between 10 and 20 seconds. Busy tone shall be sent to the blocked extension;

(3) Shall connect long distance subscriber lines upto 10Km on PIJF Telephone Cables

7.5.1.10 Redundancy for the important interfaces/modules such as power supply, processor etc. shall be provided.

7.5.1.11 The PBX Network shall be designed such that there is redundancy and diversity in terms of the communication links for call routing and call establishment. This redundancy and diversity shall be applicable for call routing and call establishment across EDFC Phase-1 and EDFC Phase-2.

7.5.1.12 PBXs shall have separate extension cards and separate digital trunk lines for Direct Line Telephone Network to make it more reliable and non-blocking.

7.5.1.13 The system design shall ensure high system availability with minimum common mode failure allowing graceful degradation.

7.5.1.14 Network and system shall be resilient to failure providing automatic reconfiguration of equipment with minimum system loss in particular the avoidance of common mode failure of site equipment, fibre, cable and power supply and software affecting system operation.

7.5.1.15 Network architecture shall be future proofed to accommodate in the flexible manner enhancements to equipment and systems with respect to hardware and software upgrades.

7.5.1.16 PBX Network shall be synchronised to the Master Clock signal for merging into a single synchronised network along with the OFC System. The PBX Network shall have internal clock in free running mode in the event of the failure or absence of the Master Clock signal. The slip allowable in the exchange network shall confirm to ITU-T Rec. G.822. A highly resilient telephone network synchronisation scheme shall be developed possibly employing multiple fall back protection and details furnished to the Engineer for review.

7.5.1.17 Each PBX shall be powered by 48 V Battery Back-Up System provided by the Contractor. Surge protection shall be provided in each switch.

7.5.1.18 The digital extension line equipment shall be capable of data transmission simultaneously with speech (ISDN working).

7.5.1.19 All software and configuration data operating the PBX shall be stored in non-volatile memory and shall not be corrupted or lost in case of PBX failure or loss of power supply.

7.5.1.20 The Contractor shall be responsible for reconfiguration of routing table of PBXs being provided under Contract Package CP-104 required to meet the requirement of this Particular Specifications.

7.5.2 VOIP based Telephony Network

7.5.2.1 The VOIP based Telephony Network consists of Call Servers, Media Gateways, IT Network, IP Phones, NMS etc.

7.5.2.2 The Call Servers and Media Gateways of this VOIP based Telephony Network shall be equipped to support 200 IP Voice Phones and 100 IP Video Phones.

7.5.2.3 The Call Server shall have high reliability and there should not be any single point of failure. These Servers shall be provided in (1+1) hot-standby configuration in two different subnets, i.e. if one server fails the second server should provide the complete functionality and be able to take the complete load of the calls automatically without dropping of any existing call.

7.5.2.4 The Media Gateways shall be provided in (1+1) hot-standby configuration. The Media Gateways shall be able to restart automatically without human intervention when the external power supply is resumed after power failure.

7.5.2.5 The IP Video Phones at Stations shall connect to Call Servers over Wide Area Network provided under Chapter-6 of this Particular Specification. Additional layer of POE Switches if required shall be provided.

7.5.2.6 A Unified Messaging Application shall be provided for VOIP based Telephony Network with facilities such as Email, Voice Mail, Faxes, Conferencing & Collaboration(8 Ports) and Inbuilt Soft Phones. The Unified Messaging Application (UMA) shall be accessible from desktop clients and shall support features such as making/receiving calls, sending/replying/forwarding voice messages and recording live conversation. UMA shall have a unified directory that allows the IP Phones and Soft Phones to call by name and identify their correspondents. The UMA shall be equipped to support 300 users.

7.5.2.7 VOIP based Telephony Network shall be synchronized to the Master Clock signal for merging into a single synchronised network.

7.5.2.8 VOIP based Telephony Network shall provide Logical Partitioning to segregate IP to IP, IP to PBX and IP to PSTN calls as per DOT regulations.

7.5.2.9 If integration of VOIP based Telephony Network provided under this Contract and as being provided under Contract Package CP-104 is done by upgrading Telephony Servers, Media Gateways, Unified Messaging Application (UMA) and associated equipments provided at OCC under Contract Package CP-104, these shall be upgraded for 200 IP Voice Phones, 100 IP Video Phones and 300 UMA Users.

7.5.3 Voice Mail System (VMS)

7.5.3.1 The VMS provided in EDFC Phase-2 shall enable internal and external telephone users to access specific mailboxes using the following peripherals:

(1) analogue telephones using DTMF;
(2) digital telephones;
(3) CO outgoing trunks and DID trunks; and
(4) digital trunk.

7.5.3.2 Telephone users assigned with VMS shall have a unique voice mailbox which shall be password protected.

7.5.3.3 The VMS shall supports 1000 users for 24 hours a day. The system shall be expandable to 2000 users. The ports connecting to the system shall support traffic intensity offered by 1000 users in such a way that 1% GOS shall be achieved. VMS shall provide storage for a total of not less than 240 hours of voice menu and message.

7.5.3.4 If Contractor upgrade/augment Voice Mail System (VMS) being provided under Contract Package CP-104 to meet the requirements of this Particular Specification, it should be upgraded for 1000 Users.

7.5.4 Voice Recording System (VRS)

7.5.4.1 The VRS shall provide recording of stipulated voice conversations over Telephone System and Mobile Train Radio Communication System. It shall be a digital system providing sufficient capacity for recording up to 4 weeks before being overwritten. The VRS shall comply with the requirements as given below.

7.5.4.2 The VRS shall have the facility to transfer the recorded audio to removable archive CD/DVD and USB etc. for long term storage.

7.5.4.3 The VRS shall be synchronized with the Master clock System. All the recorded telephone conversation shall be date & time stamped with maximum deviation of 2 seconds.

7.5.4.4 The VRS shall be built by an array of identical modules with 1+1 protection.

7.5.4.5 The VRS shall provide simultaneous recording in both Main and Standby Modules

7.5.4.6 The VRS shall support simultaneous recording and playback without disrupting the on-line recording.

7.5.4.7 The VRS shall provide facilities for user to place a marker on the recording medium to mark any conversation on any channel or any combination of channels at any time.

7.5.4.8 The VRS shall provide search function for user to locate any part of the recording medium in terms of:

(1) date and time;
(2) by channel and; and
(3) search by marker placed by the user.

7.5.4.9 The VRS shall provide automatic gain control for voice message recording.

7.5.4.10 Following functions, as a minimum, shall be provided through the Workstation connected to the VRS:

(1) audio monitoring of any channel under recording or playback mode;
(2) recording medium movement control including playback, fast forward, fast backward, record, stop and pause; and
(3) recording medium shall indicate the recording time elapsed and the free capacity available for further recording.

7.5.4.11 The VRS shall comply with the following specifications:

1	wow and flutter	:	≤ 0.8% peak
2	frequency response	:	300 to 3400 Hz within ± 3 dB;
3	Signal to noise ratio	:	> 42 dB;
4	Cross talk immunity	:	> 60 dB at 1 KHz;
5	Distortion	:	< 3%
6	Automatic gain control level	:	±3 dB in recording level for all input

7.5.5 Telephone Network Management System

Six Laptops (latest Version) shall be provided for field maintenance. Appropriate software shall be pre-loaded onto the Laptops to access the local maintenance port of the PBX switches for system administration and management.

7.5.6 Block Wiring

7.5.6.1 All the voice circuits from the PBXs shall be terminated at the Main Distribution Frame inside the TER for distribution of the internal and external lines and interface with relevant Subsystems and Project Contractors. The circuit termination shall be of IDC (Insulation Displacement Contact) type.

7.5.6.2 All the data circuits from the PBX shall be terminated at the Digital Distribution Frame inside the TER for distribution of the internal and external lines and interfaces with relevant Subsystems.

7.5.6.3 Multi-core cables shall be provided and connected from the distribution frames inside TER to the distribution frames at the MDF for connection between the PBX and the trunk circuits of PSTN. The interface between the Telephone system and the PSTN circuits shall be at the MDF.

7.5.6.4 Telephone distribution boxes shall be provided and installed at suitable locations for intermediate distribution of the circuits from the PBX switch. The telephone distribution box shall include connection blocks for the circuits termination.

7.5.6.5 Multi-core cables shall be provided and connected from the distribution frames inside TER to the telephone distribution boxes. A minimum spare capacity of 25% shall be reserved in the multi-core cables, distribution frame and the telephone distribution boxes.

7.5.6.6 Standard RJ-11 modular socket shall be provided for termination of the telephones via plug and socket arrangement. The RJ-11 modular socket shall be connected to the nearest telephone distribution boxes to complete the connection between the PBX switch and the telephone.

7.5.6.7 Short circuit and over voltage protection device shall be provided to protect circuits from faults occurring in all outdoor cables.

7.5.7 Outdoor Telephone Cable

Polythene Insulated Jelly Filled (PIJF) Telephone Cable as per RDSO Specification No. IRS: TC 41-97 with latest amendments shall be used for extending external telephone lines out of building housing PBX.

7.5.8 System Expansion

7.5.8.1 The PBXs shall be expandable to the maximum line capacity by adding extra line cards only with the common control equipment, including the processor unit, memory modules, switching modules, power supply unit, remaining unchanged. However the software license for the full line capacity as per the wired requirement given in this PS shall be provided as part of this Contract.

7.5.8.2 It shall be possible to provide additional consoles and telephone sets by 25% of installed capacity, in the Direct Line Telephone Network without affecting its performance.

7.5.8.3 Wherever the equipment of Telephone System being provided under Contract Package CP-104 for EDFC Phase-1 is being upgraded/augmented/reconfigured by Contractor, this upgradation/augmentation/reconfiguration shall not in any way utilize available provision of expansion.

∗End of Chapter 7∗

CHAPTER 8 - MOBILE TRAIN RADIO COMMUNICATION SYSTEM REQUIREMENTS

8.1 General

8.1.1 The Contractor shall provide Mobile Train Radio Communication (MTRC) System based on GSM-R for wireless voice and data communication to support the operational and maintenance requirements of EDFC Phase-2.

8.1.2 The system shall be designed based on European Integrated Railway Radio Enhanced Network (EIRENE)'s Functional Requirements Specification (EIRENE FRS v7.3.0) and System Requirements Specification (EIRENE SRS v15.3.0).

8.2 Scope of Work

8.2.1 The Works shall include the survey, design, supply, installation, testing and commissioning of Mobile Train Radio Communication (MTRC) System on EDFC Phase-2.

8.2.2 MTRC System is being provided by Indian Railways in Deen Dayal Upadhyay-Ghaziabad section of Indian Railways (IR). As such in sections, where track alignment of Deen Dayal Upadhyay-New Bhaupur Section of EDFC is running parallel to the existing Deen Dayal Upadhyay-Ghaziabad Section of IRR, Base Station Sub-systems (BSSs) of IR will be shared by DFCCIL. However in sections, where track alignment of Deen Dayal Upadhyay-New Bhaupur Section of EDFC is taking a detour (including Link Lines) and cannot be served by Base Station Sub-system (BSS) of IR, BSSs of DFCCIL shall be provided by the Contractor

8.2.3 It is envisaged that Network Sub-system (NSS) of MTRC System of Indian Railway used for Deen Dayal Upadhyay-Ghaziabad Section shall also be used for MTRC System of EDFC Phase-2. Details of NSS of MTRC System of IR are given in Appendix-II. This NSS shall be upgraded, if required, by the Contractor to meet the requirements of EDFC Phase-2.

8.2.4 It is envisaged that all operation and maintenance activities of Base Station Sub-system (BSSs) of DFCCIL for EDFC Phase-2 shall be managed from Radio Network Management System (Radio NMS) to be provided by Contractor at OCC. Further it is also envisaged that all operational activities of Network Sub-system (NSS) pertaining to EDFC Phase-2 shall be managed from OCC either by upgrading the Client Terminal(s) provided under Contract Package CP-104 or by providing new client terminals.

8.2.5 Whenever existing equipment of MTRC System of Indian Railway for Ghaziabad-Deen Dayal Upadhyay Section are upgraded/augmented/reconfigured to meet the requirement of this Particular Specifications, the available provision for Redundancy in existing equipment shall not be compromised.

8.2.6 Whenever existing equipment of MTRC System being provided under Contract Package CP-104 are upgraded/augmented/reconfigured 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/reconfiguration they shall meet the Technical Requirement and Performance Requirement as stipulated in this Particular Specifications.

8.2.7 Scope of Supplies

8.2.7.1 Scope of supply for the MTRC System shall include, but not limited to the following:

(1) Hardware, firmware, software & licenses required for up-gradation of Network Switching Sub-system (NSS) of Indian Railway or NSS under Contract Package STP-5 to meet the requirement of this Particular Specification;

(2) Hardware, firmware, software & licenses required for up-gradation of Client Terminal(s) provided at OCC under Contract Package-104 or NSS provided under Contract Package STP-5 for all operational activities of Network Sub-system (NSS).
(3) Base Station Controller (BSC), Trans-receiver Coding Unit (TRAU/TCU) and Radio NMS complete with all hardware, firmware, Software and Licenses for EDFC Phase-2. If it is possible to upgrade the BSC, TRAU/TCU and Radio NMS provided at OCC under Contract Package CP-104 to meet the requirements of this particular specification, Contractor shall upgrade this BSC, TRAU/TCU and Radio NMS duly interfacing with Contractor of Contract Package CP-104.
(4) Base Station Transceivers (BTSs) for EDFC Phase-2. It shall include the supply of towers and antennae to be erected near the BTS.
(5) Radio Dispatcher Consoles and associated hardware/accessories, software and licenses;
(6) Cab Radios complete with Power Supply, Battery Pack, Antenna and associated hardware/accessories;
(7) Operational Radios(OPH) & General Purpose Radios(GPH) complete with battery-pack, carry-case and associated accessories;
(8) Lightning Protection Equipment;
(9) Distribution Frames;
(10) Equipment cabinets, racks and cubicles together with mounting brackets and installation material;
(11) Power supplies, cables, connectors, accessories, cabling and earthing for equipment and tower;
(12) All software and license required for operation and maintenance of the MTRC System;
(13) Any other item for fulfilling the requirements of this Contract.

8.2.8 Scope of Services

8.2.8.1 The Contractor shall liaise with WPC for issues of import licence and shall also coordinate in conjunction with DFCCIL with all concerned authorities including WPC, SACFA, Civil Aviation authorities and other local authorities and obtain necessary clearances/sanctions for installation and commissioning of the MTRC System. However, all the documents for this purpose shall be signed by DFCCIL. All License fees shall be paid by DFCCIL

8.3 Functional Requirement

8.3.1 System Services

To meet operational and maintenance requirements, MTRC System shall support the following services based on the EUROPEAN Telecommunication Standards Institute (ETSI), Global System for Mobile (GSM) Standards and additional requirements specified in EIRENE FRS & SRS documents:

(1) voice services:
  (a) point-to-point voice calls;
  (b) group voice calls;
  (c) railway emergency voice calls;
  (d) broadcast voice calls;
  (e) multi-party voice calls;

(2) data services:
  (a) text message bearer service;
  (b) bearer service for automatic fax;
  (c) bearer service for train control application;

(3) call related services:
  (a) closed user group;

(b) multi-level priority and pre-emption;
(c) advanced call handling, such as call hold, call transfer, call queuing, etc.;
(d) barring incoming or outgoing calls;

(4) railway specific applications:

(a) functional addressing including registration/deregistration by train, engine or functional number;
(b) location dependant addressing;
(c) shunting mode operations;
(d) multiple driver communications within the same train;
(e) railway emergency calls (RECs);

(5) railway specific features:

(a) set-up of urgent or frequent calls through single keystroke or similar;
(b) display of functional identity of calling/called party;
(c) fast and guaranteed call set-up;
(d) seamless communication support for train speeds up to 120 km/h;
(e) automatic and manual test modes with fault indications;
(f) control over mobile network selection; and
(g) control over system configuration.

8.3.2 Coverage and performance

8.3.2.1 The adequate coverage for a radio installed in a vehicle with an external antenna for at least 95% of the time over 95% of the track along the detours shall be available to meet the system service requirements mentioned above in Clause 8.3.1.

8.3.2.2 The adequate coverage level for an operational radio & general purpose radio at 1.5 meter above ground, for at least 95% of the time over 95% of the following designated areas along the detours shall be available to meet system service requirements mentioned above in Clause 8.3.1.

(1) all station control rooms, level crossing gate huts, equipment rooms, plant rooms, ancillary buildings and any other areas where the operation and maintenance staff may gain entry;

(2) within each depot (IMD, IMSD, Service buildings) area including all rooms, sheds and open area up to the boundaries of the depot;

(3) administrative offices & residential colonies.

(4) 200 metres on both sides from centre of track along Detours.

8.3.3 Call set-up time requirement

8.3.3.1 Call set-up time requirements shall be dependent mainly upon priority. The requirements for end-to-end call set-up performance are indicated in the table below:

SN	Call Type	Call Set-Up Time
1	Railway emergency calls	<2s
2	Group calls between drivers in the same area	<5s
3	All operational mobile-to-fixed calls not covered by the above	<5s
4	All operational fixed-to-mobile calls not covered by the above	<7s
5	All operational mobile-to-mobile calls not covered by the above	<10s
6	All low priority calls	<10s

8.3.3.2 The required call set-up times shall be achieved in 95% of cases. Call set-up times for 99% of cases shall not be more than 1.5 times the required call setup time. Set-up times shall include the time required for any translation of functional numbers internal to the EIRENE network.

8.3.3.3 Emergency calls may use fast call setup procedures. All other calls setup time (except group calls) shall be achieved with authentication procedures enabled.

8.3.4 Handover and Cell Selection

8.3.4.1 The call hand-over between the RF coverage zones of different base stations shall be, flawless and guaranteed at speeds of 0 to 120 kmph, transparent to the radio users and shall not drop/interrupt on-going calls regardless of their type and mode.

8.3.4.2 The call hand-over execution time shall not exceed 300 milliseconds, which is measured from the receipt of 'handover command' to the receipt of 'UA' after 'physical info' on the new channel.

8.3.4.3 The handover success rate shall be at least 99.5% over train routes under design load conditions.

8.3.4.4 The above requirements shall also be applicable when call hand-over is between adjacent RF coverage zones of IR and DFCCIL.

8.3.4.5 The Contractor shall submit details of the hand-over process as a part of the Definitive Design.

8.3.5 Broadcast and Group Call areas

8.3.5.1 Where fixed network users are involved in a group or broadcast call, fixed network users shall be predefined and shall not change during the course of the call.

8.3.5.2 The group or broadcast call area used shall have the effect of determining which mobile can participate in the call. It shall be possible to determine the area over which the call takes place by one, or a combination, of the following:

(1) the location of the call initiator (if mobile originated); and

(2) the identity of the group being called (e.g. All users, all trains, etc.).

8.3.5.3 Any group or broadcast calls initiated in a given location shall be broadcast over an associated area base on the location of the call originator, and also to any fixed network numbers associated with the originating location.

8.3.5.4 The definition of each broadcast or group call area should take into account operational control areas.

8.3.5.5 Mobiles configured for reception of railway emergency calls entering into a call area where a railway emergency call is on-going shall automatically join this call.

8.3.5.6 Cab Radios configured for reception of a call to all drivers in the same area, entering an area where a call to all drivers in the same area is on-going shall automatically join this call unless involved in a higher priority call or involved in a call of the same priority.

8.3.5.7 The Contractor shall be responsible for configuration of broadcast or group call area, over and above configuration already done under Contract Package-104, in consultation with Engineer.

8.3.5.8 The Contractor shall be responsible for configuration of mobiles for emergency calls, over and above configuration already done under Contract Package 104, in consultation with Engineer.

8.3.6 Mobile Equipment

8.3.6.1 Three distinct types of mobile equipment are required. These equipment shall fulfil basic services, facilities and features as specified mandatory in EIRENE FRS v7.3.0 and EIRENE SRS v15.3.0. The Contractor shall provide these mobile radio types:

(1) Cab Radios – for use by the driver of a train and/or by other on-train systems;

(2) Operational Radios (OPH) – for use by railway personnel involved in operations; and

(3) General Purpose Radios (GPH) – for general use by railway personnel involved in trackside maintenance;

8.3.6.2 It shall be possible to operate all mobiles in the frequency bands around 900 MHz, allocated for use by the Railways.

8.3.6.3 Mobile equipment shall function correctly when travelling at speeds from 0 kmph to 120 kmph.

8.3.6.4 All Mobile Equipment shall be of following power classes:

Radio Type	Power Class	Power (W)
Cab Radio	2	8
General Purpose Radio (handheld)	4	2
Operational Purpose Radio (handheld)	4	2

8.3.6.5 **Services and Facilities:** Mandatory Requirements as per EIRENE FRS v7.3.0 are mentioned as 'M'. Optional Requirements as per EIRENE FRS v7.3.0 are indicated as Y/N, where 'Y' indicates it is required under this Contract and 'N' indicates it is not required under this Contract.

(1) The following voice telephony services shall be supported for each type of mobile radio equipment.

	Cab Radio	GPH	OPH
Point-to-point voice calls	M	M	M
Public emergency voice calls	M	M	M
Broadcast voice calls	M	M	M
Group voice calls	M	M	M
Multi-party voice calls	M	Y	Y

(2) The following data applications are to be supported for each type of mobile radio:

	Cab Radio	GPH	OPH
Text message service	M	M	M
General data applications	M	Y	Y
Train control applications	Y	N	Y

(3) The following call related services are to be supported for each type of mobile radio:

	Cab Radio	GPH	OPH
Display of calling user identity	M	M	M
Display of called user identity	M	M	M
Restriction of display of user identity	Y	Y	Y

EIRENE closed user group	M	Y	M
Call forwarding:	Y	Y	Y
Call hold	M	Y	Y
Call waiting	M	M	M
Call barring	M	Y	M
Auto answer service	M	Y	M
Call supervisory information	M	N	N

(4) The following EIRENE features are to be supported for each type of mobile radio:

	Cab Radio	**GPH**	**OPH**
Functional addressing	M	M	M
Location dependent addressing (section 11)	M	Y	Y
Shunting mode	M	N/A	N
Multiple driver communications within the same train (section 5)	M	N/A	N/A
Railway emergency calls	M	Y	M

(5) The Contractor shall furnish, as part of the Definitive Design, full details of the MMIs and each of the functionalities, for all types of mobile equipment listed above.

8.3.7 Cab Radio

8.3.7.1 The Contractor shall supply 5(Five) Sets of Cab Radio with 6 Hrs Battery Back-up under this Contract.

8.3.7.2 The Cab Radio shall facilitate all mandatory functionality as defined in Clause 5.2 of EIRENE FRS v7.3.0. Besides, functionality of (i) register and deregister on-train users; and (ii) run-time diagnostics; shall also be provided in Cab Radio.

8.3.7.3 The driver man-machine interface of Cab Radio shall comprise of the display, control panel, loudspeaker and handset. The driver man-machine interface shall be suitable for viewing in direct sunlight and in darkness.

8.3.7.4 For post incident analysis, all operation speech and data calls of Cab Radio shall be recorded.

8.3.8 General Purpose Radio(GPH)

8.3.8.1 The Contractor shall supply 50(Fifty) Sets of GPH along with Battery Pack under this Contract. Further 50(Fifty) additional Battery Pack for GPH as spares shall be provided under this Contract.

8.3.8.2 The General Purpose Radio shall facilitate all mandatory functionality as defined in Clause 6.2 of EIRENE FRS v7.3.0. Besides, functionality of (i) send/receive emergency calls and (ii) computer interface shall also be provided in General Purpose Radio.

8.3.8.3 The man-machine interface of General Purpose Radio shall comprise of the display, control panel, loudspeaker and microphone. The man-machine interface shall be suitable for use both in day and night.

8.3.9 Operational Radio(OPH)

8.3.9.1 The Contractor shall supply 300(Three Hundred) Sets of Operational Radio (OPH) under this Contract.

8.3.9.2 The Operational Radio shall facilitate all mandatory functionality as defined in Clause 7.2 of EIRENE FRS v7.3.0. Besides, functionality of (i) send/receive emergency calls with facility to enable/disable and (ii) computer interface; shall also be provided in Operational Radio.

8.3.9.3 The man-machine interface of Operational Radio shall comprise of the display, control panel, loudspeaker and microphone. The man-machine interface shall be suitable for use both in day and night.

8.3.9.4 Following accessories shall be supplied along with each Operational Radio

(1) Hands free car kits;
(2) High capacity battery;
(3) Desk top and travel chargers; and
(4) Antenna adapter.

8.3.9.5 For post incident analysis, all operation speech and data calls of Operational Radio shall be recorded.

8.3.9.6 Further 100(One Hundred) additional Battery Pack for Operational Radio (OPH) as spares shall be provided under this Contract.

8.3.10 Radio Dispatcher Console (Controllers Equipment)

8.3.10.1 Following controller positions in OCC shall be provided with Radio Dispatcher Console under this Contract:

S. N.	Description	Number
1	Traffic Controller	2
2	Deployment to be identified later	2

8.3.10.2 Contractor shall also provide one Radio Dispatcher Console at TER in OCC. This shall be used for maintenance purposes.

8.3.10.3 The Radio Dispatcher System being provided of OCC under Contract Package CP-104 shall be upgraded to meet the requirement under Clause 8.3.10.1 & 8.3.10.2 of this Particular Specification or provide a new Radio Dispatcher System at OCC to meets the requirements of EDFC Phase-2. The expansion capacity in Radio Dispatcher System being provided under Contract Package CP-104 shall not be utilised by Contractor for provision of Radio Dispatcher Consoles required under this Contract. The Radio Dispatcher Console shall fulfil basic services, facilities and features as specified mandatory in EIRENE FRS v7.3.0 and EIRENE SRS v15.3.0. The functionalities required by different controllers in Radio Dispatcher Consoles are essentially same, but the control area and their configuration will differ. Radio Dispatcher Consoles shall be provided with following minimum functionalities:

(1) queue all incoming calls or call request showing the functional identity and priority of caller;
(2) emergency call shall be identified and presented on top of all calls in the queue and shown in different colour/flashing followed by calls in order of priority;
(3) allow the controller to select any of the calls from the queue in any order he likes;
(4) allow the controller to establish railway emergency call or railway operation priority call to any mobile by selection from the display;
(5) allow the controller to make, close, enter and leave group calls;
(6) allow the controller to send and receive text messages;
(7) transfer its call to another Radio Dispatcher Consoles;
(8) if a railway emergency call is not answered it shall automatically be transferred to the Chief Controller or any other controller's console as decided by the Engineer; and
(9) The Chief Controller shall have the provision of taking over the functions of any of the Traffic Controllers in their absence.

8.3.10.4 For post incident analysis, all operation speech and data calls of Radio Dispatcher Consoles shall be recorded.

8.3.10.5 It shall be possible for calls to be answered automatically according to incoming call priority.

8.3.10.6 The Contractor shall furnish, as part of the Definitive Design, full details of the MMIs and each of the functionalities of Radio Dispatcher Consoles

8.3.10.7 The Contractor shall be responsible for upgradation (if required) and reconfiguration of Dispatcher Consoles being provided to Controllers in OCC under Contract Package -104 to include requirement of this Particular Specification, in consultation with Engineer.

8.3.11 Numbering Plan and cell routing

8.3.11.1 The Contractor shall propose numbering plan compliant with EIRENE FRS v7.3.0 and EIRENE SRS v15.3.0.

8.3.11.2 The proposed numbering plan, to the extent possible, shall be consistent with numbering plan of MTRC System of Indian Railway as issued vide RDSO's letter No. STT/WL/MTRC/503 Dated 16.09.2005(Appendix-I).

8.3.11.3 The proposed numbering plan shall be developed over and above the numbering plan developed under Contract Package-104.

8.3.11.4 The proposed numbering plan shall address issue pertaining to interoperability requirements of Cab Radio and other Mobile Equipment between DFCCIL and Indian Railway.

8.3.11.5 The proposed numbering plan shall be submitted to the Engineer for review before implementation.

8.3.12 Allocation of Priorities

8.3.12.1 At least five levels of priority shall be defined. The order of priority for different type of calls shall be implemented with the approval of the Engineer. Cab Radios and the Radio Dispatcher Consoles in OCC shall be configured for priorities for various situations.

8.3.12.2 To ensure interoperability between DFCCIL and Indian Railway, priorities shall be allocated consistently.

8.3.13 Call Restriction

8.3.13.1 Various types of call restrictions may be employed by the Employer as an additional security measure. Call restriction facility shall be available and implemented as required by the Engineer. Implementation of such call restrictions shall not affect interoperability between DFCCIL and Indian Railway.

8.3.14 Group Membership

8.3.14.1 A mobile may be a member of a number of groups. It shall be possible to 'activate' or 'deactivate' the mobile's subscription to these groups.

8.3.14.2 Activating a group on the mobile shall allow a user to receive a call from that group. Deactivating a group on the mobile shall prevent the user to receive calls from that group.

8.3.14.3 In order to provide interoperability, cab radios shall be members of a number of standard groups:

(1) Railway Emergency Calls,;

(2) All Train Drivers; and

(3) Shunting Team.

8.3.14.4 All mobiles with railway emergency group call subscription(s) shall be prevented from deactivating the emergency group(s) whilst operational.

8.3.15 Access Matrix

8.3.15.1 The Contractor shall develop the Voice Call Requirement Matrix in consultation with the Engineer and submit the same to the Engineer for review and approval. This Voice Call Requirement Matrix shall be developed over and above Voice Call Requirement Matrix developed under Contract Package CP-104.

8.3.15.2 Voice Call Requirement Matrix shall include additional Controllers Equipment and Mobile Equipment as specified by the Engineer during the execution of the Contract.

8.3.16 Telephone Interconnect Call

8.3.16.1 Designated Hand portable radios shall have the capability of initiating or receiving telephone calls from designated telephones directly without the Controller's intervention.

8.3.16.2 Controller's console shall have the facility to connect to a telephone subscriber PSTN/PBX as telephone interconnects call. By a three party conference it shall be possible for the controller to patch a radio user and a land line telephone subscriber, not authorized to make telephone interconnect call.

8.3.16.3 Three party conferences between controller, Station Master and Driver/Guard shall be provided.

8.3.16.4 Normally all radio users shall be barred from receiving incoming telephone calls or from making outgoing telephone calls. Designated radio users shall only be allowed the facility of telephone interconnect calls. Telephone interconnects calls from/to unauthorised radio/telephone users shall be rejected. The Contractor shall submit full details in this connection.

8.3.17 All voice communications of Radio Dispatcher Console, Cab Radio and Operation Radio shall be recorded by the Voice Recording System (VRS) being provided under Contract Package-104. The Contractor shall be responsible for upgradation/reconfiguration, if required, of Voice Recording System (VRS) being provided under Contract Package-104 or provide a new Voice Recording System (VRS) at OCC to meets the requirements of EDFC Phase-2.

8.3.18 Radio Network Management System(Radio NMS)

8.3.18.1 The Radio Network Management System shall be a centralised control system with management workstation, system database and mass storage device to be located at OCC.

8.3.18.2 The Contractor shall either supply a new Radio Network Management System or the existing System shall be upgraded for network elements of EDFC Phase-2.

8.3.18.3 The Radio Network Management System shall facilitate all management function mentioned below for Network Elements pertaining to Base Station Sub-systems consisting of Base Station Controllers(BSCs), Base Transceiver Stations(BTSs), TRAU, Interfaces etc. of DFCCIL for New Bhaupur-Deen Dayal Upadhyay Section and Radio Dispatcher Consoles.

8.3.18.4 The purpose of Radio NMS is to provide network management capabilities/features that will assist in efficient management of network. The Radio NMS shall be required with wide range of capabilities and scalability. The Contractor shall deliver a Radio NMS that supports all relevant aspects, including, but not be limited to Fault Management (FM), Performance Management (PM), Configuration Management (CM) and Security Management for all network elements controlled by it.

8.3.18.5 The Radio NMS shall allow users to interact with the system and the network elements controlled by it in a user friendly and efficient way. The Radio NMS applications designed with several hierarchical levels of GUIs, shall have the possibilities to present critical events on all GUI levels.

8.3.18.6 The Contractor shall provide detailed descriptions for all NMS interfaces, including but be not limited to, those for Configuration Management, Fault Management and Performance Management.

8.3.18.7 **Configuration Management**

The NMS shall be provided with a user view of all administrable data stored in each managed Network Element that accurately reflects the actual data stored in the managed Network Element in real or near-real time.

(1) The NMS shall provide the possibility to perform configuration management (addition/changes/deletion), directly and by using command files.

(2) The NMS shall provide the possibility to manage command files (creation/changes/deletion).

(3) The NMS shall provide the possibility to add/change/ delete the configuration data for physical equipment and connections simply by choosing the concerned item (e.g. drop down menu).

(4) In case a user action has an impact on the operational service, a dialog box shall warn the user and give the possibility to cancel the last action.

(5) The NMS shall not allow adding/changing/deleting a connection without verification (end to end consistency check).

8.3.18.8 **Fault Management**

(1) The Radio Network Management System shall provide following fault management functionality.

(a) The NMS shall collect, display and manage alarms and notification with severity level for all the BSS equipment, interfaces and its own equipment;

(b) It shall be possible to define alarms category and severity level and their display shall be customisable;

(c) The alarms and notifications shall indicate the network element in which the event occurred, time, data, level, reason (description) and other important data;

(d) The alarms shall be automatically cleared from the display when impacted equipment is again in nominal service;

(e) User shall have the possibility to easily get information about each displayed alarm and clear or acknowledge a displayed alarm;

(f) All the alarms and notification shall be stored during at least 30 days and it shall be possible to search in the alarm history for certain alarms by filtering on any alarm information;

(g) Information about the state of the network element shall be displayed with the maximum delay of 10 seconds (in respect of the event origination moment).

(2) The following alarm conditions shall be provided to the Radio Network Management System as a minimum:

(a) loss of communication links;
(b) loss of Master Clock synchronisation;
(c) failure of power supply unit;
(d) changeover to redundant central equipment;
(e) base station health status;
(f) central equipment health status;
(g) low power and no power alarms for all transmitters; and

(h) indication of receiver failures.

8.3.18.9 **Performance Management**

(1) The NMS shall provide data concerning the performance of the individual element of BSS and individual channels with respect to traffic volume so as to optimise the system configuration, equipment deployment, user grouping and future sizing of the system.

(2) The NMS shall produce statistical reports on the channel usage and system performance. It shall have the facility to monitor base station channel traffic on real time basis. It shall allow flexible adaption of traffic configurations to the dynamic traffic requirements.

(3) The NMS shall give detailed information about handover (successful / unsuccessful / retry), all type of calls, all type of call drop, traffic and congestion, group calls (successful/failed/cells per GC) etc. These data shall be stored for a minimum of 1 week. The collected data shall be "transparent" i.e. workable without additional calculation.

8.3.18.10 **Security Management**: As part of the NMS solution the functions related to security is of high importance. Such function(s) shall be provided to avoid and protect against unauthorized access and manipulation in conformance to governing security policy. Some of these required functions are given below:

(1) The NMS equipment shall be protected from access by unauthorized persons and guarantee access to authorized users exclusively according to their respective rights.

(2) Authorized users shall have remote access to NMS systems.

(3) All the actions shall be logged with the associated user, and these data shall be stored at least 1 week.

(4) The access for up to 3 parallel users shall be possible without limitations.

8.3.18.11 **Restoration**: The Network Management System shall provide following restoration features

(1) The NMS shall be equipped with data media capable of storing information to be used for saving the software and settings.

(2) In case of the program failure of any NMS component, restoration of data saved in that medium before the failure shall be ensured.

(3) The Contractor shall precise the NMS data restoration duration for main server and terminal equipment.

(4) The Contractor shall precise the NMS complete system restoration duration for main server and terminal equipment.

8.3.18.12 The NMS shall support integrated trace management function for end to end call tracing. It shall be possible to specify the call to be traced by setting the caller number or called number. It shall be possible to save the result of the tracing to the NMS console for future reference. Any performance limitation related to tracing during live traffic shall be described.

8.3.18.13 **System Management Printer**: The Network Management System shall be equipped with a common maintenance printer for the production of hard copies of graphical screen information, system parameter data, maintenance fault history, listing of pre-defined system information and various performance management reports. The maintenance printer shall be connected to the radio management system Workstation.

8.3.19 Subscriber Management

8.3.19.1 The day-to-day administration, management and control of MTRC System of DFCCIL for New Bhaupur-Deen Dayal Upadhyay section shall be carried out in real-time from OCC through suitable Client Terminal(s) being provided under Contract Package-104.The

Contractor shall upgrade existing Client Terminal(s) provided under Contract Package-104 to meet the requirement of this Particular Specification if possible or provide new Client Terminal to meet the requirement of EDFC Phase-2.

8.3.19.2 Some of these functions related to administration, management and control of MTRC System of DFCCIL for New Bhaupur-Deen Dayal Upadhyay section are given below:

(1) configure(create/change/delete) the numbering plan including functional numbering plan;

(2) implement call-barring to prevent uninterrupted access by non-authorized users;

(3) define/configure subscription profiles of mobile equipment;

(4) allocate priorities to calls;

(5) define access class;

(6) implement close user group;

(7) manage of functional numbering i.e. define, modify or remove relationship between Functional Numbers and MSISDN Numbers;

(8) manage the access of mobile equipment to the functional numbering scheme for registration, de-registration and re-registration;

(9) implement forced deregistration;

(10) define the information exchanged between the mobile and network for registration and deregistration;

(11) define, modify or remove relationship between Engine Number and MSISDN;

(12) define routing path using short codes for location dependent addressing;

(13) configure railway emergency group call area;

(14) configuration of Group IDs as per EIRENE FRS v 7.3.0 & SRS v 15.3.0; and

(15) retrieve recorded calls using search criteria.

8.3.19.3 Through these Client Terminal(s) it shall be able to perform configuration management (addition/change/deletion), directly or by using command files. It shall be able to configure data of physical equipment by choosing the concerned equipment from drop-down menu. It shall also be possible able to manage (creation/change/deletion) command files.

8.4 Performance Requirements

8.4.1 General

The following performance requirements for the Radio system shall be complied:

8.4.2 Reliability Requirements

The Contractor shall furnish for the following sub-systems/equipment, the reliability figures, MTBF years from the OEMs:

(1) MSC sub components
(2) Base Station Controller (BSC)
(3) Base Transceiver Station (BTS)
(4) Radio Network Management System(Radio NMS)
(5) Radio Dispatcher Console (RDC)
(6) Cab Radio
(7) General Purpose Radio (GPH)
(8) Operational Radio (OPH)
(9) Any other equipment forming part of the system.

8.4.3 Availability Requirements

8.4.3.1 The Contractor shall implement a RAMS Plan defined in accordance with IEC 62278. Any degraded mode of operation or re-configuration functions provided by the MTRC System shall not be included in the determination of the system availability.

8.4.3.2 The conditions which shall be considered as failures shall include, but not be limited to:

(1) failure to initiate individual voice call;
(2) failure to initiate voice group call;
(3) failure to initiate railway emergency call;
(4) failure to initiate shunting emergency call;
(5) failure to initiate voice broadcast call;
(6) failure of Location Dependant Addressing;
(7) failure of Functional Addressing;
(8) failure of any one base station causing gap in RF coverage; and
(9) failure of Radio Dispatcher Console unable to receive a call.

8.4.3.3 The MTRC system shall have an overall availability of better than 99.99%.

8.4.3.4 The Network Management System shall be considered unavailable if any of the functions provided by the system cannot be properly exercised. The availability of the Network Management System shall be better than 99.95%.

8.4.3.5 Wherever the existing equipment of MTRC System of Indian Railways for Ghaziabad-Deen Dayal Upadhyay Section is being upgraded/augmented/reconfigured, this upgradation/augmentation/reconfiguration shall not in any way compromise the reliability, fault tolerance and capacity of supporting non-stop on line call processing.

8.4.3.6 Wherever the equipment of MTRC System being provided under Contract Package-104 for New Khurja-New Bhaupur Section is being upgraded/augmented/reconfigured, this upgradation/augmentation/reconfiguration shall not in any way compromise the reliability, fault tolerance and capacity of supporting non-stop on line call processing

8.4.4 Maintainability Requirements

8.4.4.1 Service life of the MTRC system/equipment shall not be less than 15 years.

8.4.5 System Safety Requirements

8.4.5.1 All equipment shall comply with and be installed in conformance with IEC 60950 and IEC 60364 or equivalent National Electric Code/Uniform Building Code of safety standards.

8.4.5.2 All metallic enclosures shall be provided with an earth terminal and connected to earth.

8.4.6 Interoperability Requirements

8.4.6.1 Base station subsystem (BSS) being provided under this contract shall comply with the inter-operability requirements for mobile equipment (Cab Radio & Hand Portable as per EIRENE) specifications to be supplied under this contract, in use over Indian Railways and to be supplied for other GSM-R networks of DFCCIL.

8.4.6.2 The mobile equipment (Cab Radio & Hand Portable as per EIRENE)specifications to be supplied under this contract shall comply with the inter-operability requirements with BSS in use over Indian and to be supplied for other GSM-R networks of DFCCIL

8.4.6.3 BSS being provided under this Contract shall be inter operable with Network Sub System (NSS) being provided for WDFC under Contract Package STP-5 and should be supported with conclusive IOT documentation.

8.5 Technical Requirements

8.5.1 General

8.5.1.1 The MTRC System shall be designed based on European Integrated Railway Radio Enhanced Network (EIRENE)'s Functional Requirements Specification (EIRENE FRS

v7.3.0 or latest) and System Requirements Specification (EIRENE SRS v15.3.0 or latest). The main components of the system shall be:

(1) Base Station Sub-system (BSS) of Base Station Controller (BSC) controlling Base Transceivers Stations (BTSs) each containing a number of transceivers (TRXs).

In sections, where track alignment of EDFC Phase-2 is running parallel to the existing Ghaziabad-Deen Dayal Upadhyay Section of Indian Railway, Base Transceivers Stations (BTSs) of Indian Railway will be shared by DFCCIL. Any up-gradation or strengthening required at BTSs of Indian Railway, for smooth handover between BSSs of Indian Railways and DFCCIL, shall be done by the Contractor.

However in sections, where track alignment of EDFC Phase-2 is taking a detour and cannot be served by Base Transceivers Stations (BTSs) of Indian Railway, new Base Transceivers Stations (BTSs) of DFCCIL shall be provided by the Contractor for adequate RF coverage. These BTSs shall be controlled by BSC at OCC. This Base Station Sub-system (BSS) can be provided either by upgrading and using Base Station Controller (BSC) being provided under Contract Package CP-104 at OCC to meet the requirements of EDFC Phase-2 or by providing a new Base Station Controller (BSC) at OCC. This new BSC should be upgradable to meet the requirement of contract packages CP-104, CP-105.

This BSC shall either be linked to the existing Network Sub-system (NSS) of MTRC System of Indian Railway used for Deen Dayal Upadhyay-Ghaziabad Section or to NSS of WDFC under contract package STP-5. Accordingly BSC and associated network elements constituting the Base Station Sub-system (BSS) shall be compatible with this Network Sub-system (NSS) of MTRC System of Indian Railway used for Deen Dayal Upadhyay-Ghaziabad Section and Network Sub System (NSS) being provided for WDFC under Contract Package STP-5. The Base Station Sub-system (BSS) should fulfil all interoperability criteria with existing Network Sub-system (NSS) of MTRC System of Indian Railway and should be supported with IOT documentation. Base Station Sub-system (BSS) to be provided under this Contract shall be capable of supporting data communications for Train Control System i.e. ETCS Level-2.

(2) Network Sub-system(NSS) containing Mobile Services Switching Centre (MSC) with primary responsibility for call control shall be supported by a Visitor Location Register (VLR) containing temporary details of subscribers active within the MSC area, a Group Call Register (GCR) containing attributes of voice group and broadcast call configurations for the related MSC area, Home Location Register (HLR) holding subscribers details on a permanent basis and IN platform based on CAMEL (Customised Application for Mobile Enhanced Logic).

It is envisaged that either Network Sub-systems (NSS) of MTRC System of Indian Railway used for Deen Dayal Upadhyay-Ghaziabad Section or NSS of WDFC under contract package STP-5 shall also be used for MTRC System of EDFC Phase-2. As such Network Sub-system (NSS) of MTRC System of Indian Railway or of WDFC shall be suitably augmented/upgraded by the Contractor to meets the requirements of EDFC Phase-2.

(3) Telephone Interface Equipment to facilitate call between GSM-R Users (RDC, Cab Radio, OPH & GPH) and Telephone System (PBX Network) as covered in Chapter-7 of this Particular Specification.

As Network Sub-system (NSS) of MTRC System of either Indian Railway used for Ghaziabad-Deen Dayal Upadhyay Section or NSS of WDFC under contract package STP-5 shall also be used for MTRC System of New Bhaupur–Deen Dayal Upadhyay Section of EDFC, Telephone Interface Equipment provided along with this NSS shall be suitably augmented/upgraded by the Contractor to meet the requirements of New Bhaupur-Deen Dayal Upadhyay Section of EDFC.

(4) Voice Recording System (VRS) interfaced to above Network Sub-systems (NSS) for recording voice communications taking place on RDC, Cab Radio and OPH. All voice communications of Radio Dispatcher Console, Cab Radio and Operation Radio shall be recorded by the Voice Recording System (VRS) This Voice Recording System (VRS) can be provided either by upgrading and using Voice Recording System (VRS) being provided under Contract Package CP-104 at OCC or by providing a new Voice Recording System (VRS) at OCC to meet the requirement of EDFC Phase-2.

(5) Short Message Service Centre (SMSC) interfaced to above Network Sub-systems (NSS) for exchange of text messages. This Short Message Service Centre (SMSC) can be provided either by upgrading and using Short Message Service Centre (SMSC) being provided under Contract Package CP-104 at OCC or by providing a new Voice Recording System (VRS) at OCC to meet the requirement of EDFC Phase-2.

a) Mobile equipment which includes Cab Radios, Operation Purpose Handset & General Purpose Handset interfacing to the BSSs.

b) Radio Dispatcher Console provided at OCC.

c) Subscriber Identity Modules (SIM) containing information specific to single subscriber.

d) Radio Network Management System (Radio NMS) at OCC for managing the Base Station Sub system(BSS) of New Bhaupur-Deen Dayal Upadhyay Section of EDFC. .

8.5.1.2 Mobile Switching Centre of IR for Ghaziabad-Deen Dayal Upadhyay Section shall be suitably upgraded/augmented for additional capacity of 600 Mobile Equipment (Cab Radio, OPH & GPH) and 6 Radio Dispatcher Consoles. This upgradation/augmentation shall not in any way compromise the reliability, fault tolerance and capacity of supporting non-stop on line call processing. The connectivity (Communication Link) between BSS of EDFC Phase-2 and Network Sub-system (NSS) of MTRC System of Indian Railway used for Deen Dayal Upadhyay-Ghaziabad Section shall be provided by Employer.

8.5.1.3 All major equipment and component of the MTRC System being provided under this Contract shall have redundant engineering to minimize the effects of the failure of such equipment to the operations and performance of the MTRC System and in turn meets the Availability Requirements stipulated in Clause of this Particular Specification.

8.5.1.4 Base Station Sub-system (BSS) & Radio Network Management System (Radio NMS) shall be supplied with fault-tolerant architecture to prevent common mode failure so as to ensure continuous operation with minimal loss of facilities in the event of equipment failure.

8.5.1.5 Redundant routing shall be adopted for all fixed telecommunication links and redundant equipment shall be installed within critical components e.g. additional redundant cards.

8.5.1.6 The MTRC System shall support all EIRENE-compliant Mobiles Equipment from different manufacturers.

8.5.1.7 Software shall be designed to accommodate the ultimate, fully expanded capacity, without requiring any change to the hardware or firmware of the installed system and without adversely affecting the overall operation or performance of the MTRC System.

8.5.1.8 The Contractor shall supply the 40 (Forty) GSM-R SIM cards for use with normal GSM mobile sets under this Contract:

8.5.1.9 The Contractor shall submit, as part of the Definitive Design, to the Engineer for review, the full details of all interfaces available at the Cab Radio and Radio Dispatcher Console.

8.5.1.10 OEM's original specifications (data sheets) and other configuration details as a minimum for all equipment listed below shall be submitted with the Preliminary/Definitive Design submissions for review by the Engineer:

(1) all sub-component of Base station System (BSS) including Base Transceiver Station(BTS), Base Station Controller, TRAU etc.;
(2) all sub-component required for upgradation/augmentation of Network Sub-system(NSS);
(3) Radio Network Management System(Radio NMS);
(4) Radio Dispatcher Consoles and associated hardware for OCC;
(5) Cab Radio complete with antenna & MMI;
(6) Operational Purpose Radio (OPH);
(7) General Purpose Radio (GPH);
(8) Antennas of various types;
(9) Subscriber Identification Module (SIM); and
(10) All other equipment, including requirements for interfacing with other sub-systems and other project contractors, forming part of the radio system.

8.5.1.11 All the radios including base stations, hand portable radio and Cab radio shall have a port for field programming and diagnostic access through a Notebook Computer.

8.5.2 Frequency Planning

8.5.2.1 The use of radio frequency (RF) spectrum in India is regulated by the Wireless Planning and Co-ordination (WPC) Wing of the Ministry of Communications, Government of India. MTRC System shall operate within the frequency band of 952.8-954.4/907.8-909.4 MHz. The Employer has been authorised the use of eight frequency pairs in band 952.8-954.4/907.8-909.4 MHz for MTRC System. However, based upon frequency plan separate clearance for the use of specific frequencies shall be obtained from WPC by the Employer. The Contractor shall provide necessary documentary support for this purpose. The Contractor, if so required by the WPC, shall incorporate specific changes in the frequency plan, after mutual discussions.

8.5.2.2 The Contractor shall prepare a comprehensive frequency plan for MTRC System of New Bhaupur-Deen Dayal Upadhyay Section of EDFC along with MTRC System being provided by Indian Railways in Ghaziabad-Deen Dayal Upadhyay section of Indian Railway. This comprehensive frequency plan shall address issues like overlap, overreach, interference etc. Any upgradation/replacement/shifting/configuration in BTSs of MTRC System being provided by DFCCIL in EDFC Phase-1 or Indian Railways in Ghaziabad-Deen Dayal Upadhyay section for implementation of comprehensive frequency plan shall be carried by the Contractor.

8.5.2.3 The Contractor shall perform radio frequency planning ensuring efficient use of the available frequency pairs. The frequency plan including detailed calculations shall be submitted to the Engineer for review, as part of the Design.

8.5.2.4 If after conclusion of Radio Planning it is concluded by the Engineer and the Contractor that additional frequency pairs shall be required; Employer will take necessary action to obtain such additional frequency pairs from WPC. The Contractor shall provide necessary documentary support for this purpose.

8.5.2.5 The system design shall have suitable safeguards to ensure that the operation of a radio set from any other system, except MTRC System of Indian Railway, is debarred, and its operation does not affect the operation of MTRC System of DFCCIL in any way.

8.5.2.6 Frequency planning calculations shall ensure that there will be no interference from frequencies within the systems DFCCIL. RF coverage plots to show that there will be no interference from frequencies within the system shall be submitted to the Engineer for review. In case of interference from other systems outside DFCCIL, the Contractor shall inform the Engineer of such violations and will support the Engineer with necessary data/test results to enable the Employer to address and settle the issue with other systems.

Remedial action to overcome the interference, if any required, shall be taken by the Contractor.

8.5.3 Radio Frequency Coverage

8.5.3.1 In sections, where track alignment of New Bhaupur-Deen Dayal Upadhyay Section of EDFC is taking a detour from Bhaupur -Deen Dayal Upadhyay section of Indian Railway and cannot be served by Base Station System (BSS) of Indian Railway, new Base Station System (BSS) of DFCCIL shall be provided by the Contractor.

8.5.3.2 Base Station System (BSS) network shall be planned with an appropriate radio network planning tool and an appropriate propagation model for the terrain being covered. Details of the tool and the methodology adopted shall be submitted to Engineer.

8.5.3.3 The Contractor shall submit detailed link budget analysis and RF Signal coverage plots both for up-link and the down link for Cab Radio and OPH/GPH (indoor and outdoor coverage) for each base station, to confirm that the required RF coverage stated above can be achieved using the Contractor's proposed antenna system and their locations. Assumptions like dense urban, urban and sub-urban etc. and the specifications of the base station equipment including TX/RX, RF cables, splitters, directional couplers, antenna etc. and the specifications of Mobile Equipment adopted for link budget calculations shall be detailed.

8.5.3.4 The coverage level for a radio installed in a vehicle is defined as the field strength at the antenna on the roof of a train (nominally a height of 4m above the track). An isotropic antenna with a gain of 0dBi is assumed.

8.5.3.5 The coverage level for a radio is defined as minimum field strength of downlink available at 4 metre above ground for atleast 95% of the time over 95% of the area. The Gaziabad-Mugalsarai Section of Indian Railways is being provided with minimum coverage level of –95 dbm above Railway Track.

8.5.3.6 The coverage level shall be designed to provide satisfactory indoor and outdoor coverage in detour section for an operational radio and general purpose radio for all areas as specified, including indoor areas for which an extra margin shall be considered. Accordingly minimum coverage level of -78 dbm in outdoor terrain shall be available.

8.5.3.7 The above mentioned signal strength levels are the worst case downlink signal strength level after taking into account all losses such as propagation loss, feeder losses, fading, climatic losses etc.

8.5.3.8 RF coverage and Quality of Service shall be designed for future implementation of ETCS Level 2 for speeds lower than or equal to 120 Km/h.

8.5.3.9 Coverage in the two way communication is decided by the weakest transmission direction. It is therefore necessary to balance the up and down paths.

8.5.3.10 Diversity reception shall be provided for protection against failure in receive antennas or receiver multi-couplers and to provide gain in the Up-Link path.

8.5.3.11 The Contractor shall submit the particulars of locations of radio base station sites, requirements of antenna and aerial support structure (radio towers) necessary to provide the specified area coverage indicating full indoor and outdoor coverage as specified above. The MTRC System shall have tower mounted antennae for wide area coverage.

8.5.3.12 RF signal strength/coverage shall be measured for outdoor as well as indoor areas for down link and results submitted to the Engineer for review as part of System Acceptance Test. To improve the indoor coverage additional measures shall be taken by the Contractor if so required.

8.5.4 System Radio Channel Requirements

8.5.4.1 The MTRC System shall not provide traffic blocking exceeding 1%. Traffic calculations considering all radio communication needs of fixed and mobile radio subscribers to establish these requirements shall be submitted as part of Definitive Design. Requirements

of radio communications during emergencies and crisis management should also be considered.

The MTRC System shall support the following modes of traffic as a minimum:

(1) Normal traffic, this shall be the communication between radios under the RF coverage zone of the same base station.

(2) Inter-base station traffic, this shall be the communication between radios under the RF coverage zones of different base stations.

(3) Emergency traffic shall be the communications during emergency operations.

8.5.4.2 The MTRC system shall as a minimum be equipped with 6 traffic channels, both for voice & data on IR and EDFC routes.

8.5.5 Communication between BTSs and BSC

8.5.5.1 Base Transceiver Stations (BTSs) shall be linked to the BSC through a logical ring network structure, so that link failure on one side shall not affect the availability of the mobile network in any way. All interconnections forming the ring, being BTS-BTS or BTS-BSC shall be realised in a separate geographical/physical route.

8.5.5.2 The logical BTS-ring structure shall provide protection switching for all channels/bandwidth between BTS and BSC. BTS shall have dual ports for connection in the ring configuration. A maximum of 4 BTSs shall be allowed in one logical ring.

8.5.6 Cab Radio

8.5.6.1 Cab Radios shall meet all mandatory system requirements as defined in EIRENE SRS v15.3.0. Besides, it shall also meet all system requirements required to comply with this Particular Specification.

8.5.6.2 Cab Radios shall meet all Environmental and Physical requirements as mentioned in Clause 5.7 of EIRENE SRS v15.3.0.

8.5.6.3 Rolling Stock to be equipped with Cab Radio shall have DC Power Supply from 110V Battery Bank with Voltage range of 90V-130V, which will be used for powering up Cab Radios. Power Supply Unit required for conversion of 110 V DC to any other voltage required shall be provided by the Contractor. All wiring/cabling from 110 V DC Power Source to Cab Radio shall be done by the Contractor. Required protection circuits such as Over voltage protection or Short-circuit protection shall be provided by the Contractor.

8.5.6.4 Cab Radio Man-Machine Interface

(1) Cab Radio Man Machine Interface shall comprise of the following components:
- display;
- control panel;
- loudspeaker;
- handset with push –To-Talk button.

(2) Cab Radio equipment installed in a driver's cab shall not obstruct the driver's vision or otherwise hinder the safe driving of the train.

(3) Layout of the equipment in the cab shall be decided in consultation with the Engineer.

(4) The Cab Radio shall be provided with sufficient filtering and suppression circuit to make it immune to radio interference.

(5) Two identical input power from rolling stock power supply in main and hot standby mode of operation shall feed the cab radio unit. The switchover from the main to hot-standby power supply shall be transparent and not cause any loss in communication to the radio users. The Contractor shall use converters, if required, to power the Cab Radio.

(6) All call related functions except talking shall be possible with the handset on or off the hook.

(7) The driver shall be able to adjust the brightness of buttons, indicator lights and display according to the ambient lighting in the cab.
(8) The driver shall be able to adjust the contrast of the display.
(9) The emergency call button shall be red and shall be protected against accidental use.
(10) Any displays shall be clearly readable from a normal driver's position, assuming a normal reading distance.
(11) Display characters shall have a minimum height of 5 mm.
(12) MMI shall be splash proof and suitable for viewing in direct sun light and in darkness.
(13) Cab radio shall prevent tampering.
(14) If contact with the mobile radio network is lost, the cab radio shall give an audio and visual indication.
(15) Driver Man-Machine interface shall be installed in the leading cab and also the trailing cab (if available) of each rolling stock.
(16) Facilities shall be provided to support a list of stored names /numbers of up to a minimum of 100 entries.
(17) Abbreviated dialling facility shall be supported.

8.5.6.5 Built-in Test Routine

(1) Built-in test routines shall be able to test the cab radio and the radio MMI. These routines shall operate in an off-line mode to allow a complete functional test of the module in problem.

(2) The Contractor shall ensure that upon every initialization cab radio shall perform automatic self-diagnostic routine test on the all Train borne radio Communication Equipment. An audible tone shall indicate the readiness state of the Train Radio Communication System and associated equipment.

(3) The fault and self-diagnostics information shall be processed and sent to the dispatcher's console (specific RDW to be decided during design) to indicate the status of the cab radio to facilitate prompt fault diagnosis and enable DFCCIL staff to locate faulty modules for first line replacement.

(4) The cab radio shall be provided with a radio test port to enable full specification testing. The port shall be able to interface to a Notebook Computer. The selection of functions and data to be monitored shall be menu driven by the Notebook Computer. The data indicating the cab radio's performance shall be displayed in an informative and comprehensive manner. Information shall be presented graphically where possible. The Contractor shall provide a full description of cab Radio performance functions to be monitored, as well as those which are not monitored.

8.5.6.6 Run Time Diagnostics

(1) The cab radio shall be capable of performing a suite of runtime diagnostic tests on all physical interfaces.
(2) Failure of an interface shall be reported to the driver via the display on the MMI indicators.
(3) All failures shall be recorded in the activity log at OCC.
(4) Diagnostic tests shall not interfere with normal operation of the cab radio.

8.5.6.7 Cab Radio Antenna

(1) The antenna shall be mounted suitably on the roof of the rolling stock to meet the required performance specifications without causing any electromagnetic interference to other equipment on board the Train.
(2) The Contractor shall submit the drawings showing the placement of the antenna on the roof of the rolling stock. The low profile antenna on the roof of the rolling stock shall not infringe the schedule of dimensions.

(3) The antenna and mounting brackets shall be extremely rugged low profile design and shall withstand the effects of washing plants, mechanical vibration, dust accumulation and other physical hazards typical of railway environments.

(4) Where applicable, the antenna feed shall consist of pre-terminated, double screened, flexible, 50 Ohm, RF feeder cable. The feeder routing shall be designed to avoid effects of EMI.

(5) The orientation and placement of the antenna on the roof of the rolling stock shall ensure minimum VSWR and maximum coupling of RF signal.

(6) Cab radio antenna shall as a minimum comply with requirements of Shock and vibrations etc. The Contractor shall submit to the Engineer for review complete specifications/OEM's datasheets of cab radio antennas considered in the RF coverage design.

(7) Cab radio antenna shall be separated from other antennas to ensure no desensitization.

8.5.7 Operational Purpose Radio

8.5.7.1 Operational Radios shall meet all mandatory system requirements as defined in EIRENE SRS v15.3.0. Besides, it shall also meet all system requirements required to comply with this Particular Specification.

8.5.7.2 Operational Radios shall meet all Environmental and Physical requirements as mentioned in Clause 7.5 of EIRENE SRS v15.3.0.

8.5.8 General Purpose Radio

8.5.8.1 General Purpose Radios shall meet all mandatory system requirements as defined in EIRENE SRS v15.3.0. Besides, it shall also meet all system requirements required to comply with this Particular Specification.

8.5.8.2 General Purpose Radios shall meet all Environmental and Physical requirements as mentioned in Clause 6.4 of EIRENE SRS v15.3.0.

8.5.9 Antenna Towers at Radio Base Stations

8.5.9.1 The towers shall be designed and constructed for working and installation in the geographical and environmental conditions.

8.5.9.2 All towers shall comply with the requirements of Standard EIA/TIA-222-EG and Indian Standard IS-800, 808, 226/2062, 1367, 1161, 2629, 5358. In case of any conflict between the two standards, the Indian Standards shall prevail. Contractor shall always immediately seek advice from the Engineer in the event of conflict.

8.5.9.3 The towers shall be self-supporting steel structure. The maximum height of the tower shall normally not exceed 40 metre. However in exceptional circumstances, higher height may be permitted by the Engineer.

8.5.9.4 All steel used shall be hot dip galvanised in full compliance with the relevant ISO or ASTM specifications or IS 4759. The galvanised tower members shall further be treated suitably to protect from rusting.

8.5.9.5 Any damage to the galvanising during the erection shall be made good by the Contractor before acceptance by the Engineer.

8.5.9.6 The towers shall be designed to withstand a minimum wind load of 200 kmph or the maximum wind speed of the concerned zone as currently defined by the Indian Meteorological Department (whichever is higher) while supporting the maximum number of antennae plus two additional antennae required of the same type/size, located at full height.

8.5.9.7 For design purposes, the combined projected area of these antennae shall be maximised against the wind direction.

8.5.9.8 The tower loading as a minimum must take into account the wind load, seismic conditions, load of antenna, antenna support structures, live load of installation and maintenance staff,

all tower accessories and at least 100% safety margin against structural failure for the actual anticipated configuration.

8.5.9.9 The Contractor shall design/build/erect the base/ foundations/ earthing/ fencing of the tower. It is expected that the foundations can be constructed from standard concrete and reinforcing steel. However, the Contractor shall ensure the adequacy of the soil bearing pressure to support the weight of the tower including all accessories, antennae support structures and live load of installation and maintenance staff and to resist the overturning moments generated in the survival wind speed. During construction of the Tower foundation, the Contractor shall be responsible for the safety of the site and the structures nearby. The earthing design shall be as per IS 3043 or better standard for Radio Towers and the foundation and earthing design shall be got approved from the Engineer before implementation.

8.5.9.10 A rest platform with guard railing and seat every 20 m. and a 400mm wide climbing ladder with 20 mm diameter rungs at intervals of 300 mm to the top of the tower shall be provided. Design of ladder, the platforms and the tower shall also consider the live load of a number of installation/maintenance personals at different levels. Working platforms at the levels where antennas are installed shall be such that these will facilitate installation and maintenance personal to work on the antennas without any additional supports and without any undue risk.

8.5.9.11 The ladder shall be securely and rigidly fixed so that the tower faces form a safety cage. Backward tilt shall not be acceptable.

8.5.9.12 The linear and torsional sway of the tower under the worst loading conditions shall be restricted to a value such that no degradation of system performance is experienced.

8.5.9.13 All tower connection nuts and bolts shall be made of steel conforming to the requirements of IS 6639, IS 13634 or ASTM A-325 or an equivalent international standard, and shall be hot dip galvanized. Lock nuts shall be provided and installed for all bolts without exception.

8.5.9.14 All towers shall be equipped with a suitable cable rack to house the feeder cable to antenna, and cable clamps of suitable design shall be provided and installed.

8.5.9.15 The towers shall be equipped with Aviation Warning Lights in conformity with the relevant requirements of ICAO.

8.5.9.16 Pockets and depressions likely to hold water shall be avoided, and where unavoidable, shall have suitable draining facility.

8.5.9.17 For earthing of the tower, holes of suitable diameter shall be made near the base of the tower. At least two earths at adequate distance apart interconnected shall be provided. The earth resistance shall be less than one ohm under all weather conditions.

8.5.9.18 The tower shall have lightning conductors of appropriate design and size, which shall be earthed through dedicated copper conductors of suitable cross section coming down from the top of the tower to the base of the tower to be grounded.

8.5.9.19 The Contractor shall submit the tower structural design, the foundation design and other details to the Engineer for review and consent.

8.5.9.20 Life of the tower shall be at least 40 years.

8.5.9.21 A means of preventing unauthorised access onto the ladder shall be provided.

8.5.10 Base Station Outdoor Antenna

The outdoor antenna shall be of robust construction utilising corrosion resistant aluminium alloy and shall be protected from lightning. The feeder cable connection shall be weather-proof and fully sealed. The Contractor shall submit complete specifications/OEM's datasheets of various types of base station antennas considered in the RF coverage design.

8.6 System Expansion

8.6.1 The MTRC System design shall cater for modular expansion at all hardware locations to accommodate future requirements and/or upgrades without the need for replacement of the installed hardware and software during the equipment lifetime. Expansion/up-gradation of the MTRC System shall be possible by addition of modules, cards/sub-racks and additional licenses for additional base stations. The contractor shall submit to the Engineer the expansion capability of various equipment and sub-systems for review.

8.6.2 The equipment installed in the TER at OCC shall meet the requirements of expansion to provide additional capacity of 25%.

8.6.3 Wherever the existing equipment of MTRC System of Indian Railways for Gaziabad-Mugalsarai Section is being upgraded/augmented/reconfigured, this upgradation/augmentation/reconfiguration shall not in any way utilize available provision of expansion.

8.6.4 Wherever the equipment of MTRC System being provided under Contract Package CP-104 for EDFC Phase-1 is being upgraded/augmented/reconfigured, this upgradation/ augmentation/reconfiguration shall not in any way utilize available provision of expansion.

∗ End of Chapter 8 ∗

CHAPTER 9 - MASTER CLOCK SYSTEM

9.1 General

9.1.1 The Master Clock System shall provide 'Synchronized Time Information' using Global Positioning System (GPS) as time source.

9.1.2 This Synchronized Time Information shall be used to synchronize slave clocks which shall be located at Stations, Depots & Offices in EDFC Phase-2.

9.1.3 This Synchronized Time Information shall also be provided to other Interfacing Systems/Sub-systems and shall be achieved by means of the Network Time Protocol (NTP).

9.1.4 Master Clock System being provided shall conform to ITU-T Recommendations G.811 and G.812 for the synchronisation timing and timing distribution requirements.

9.1.5 Whenever existing equipment of Master Clock System being provided under contract Package-104 is upgraded/augmented/reconfigured 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/reconfiguration they shall meet the Technical Requirement and Performance Requirement as stipulated in this Particular Specifications.

9.2 Scope of Supply for Clock System

The scope of supply shall include, but not be limited to, the following:

(1) A Master Clock System;
(2) GPS Receiver and Antenna;
(3) Master Clock control and distribution equipment;
(4) Sub-Master Clocks;
(5) Slave Clocks (Analogue and Digital Clock Display Units);
(6) Clock Management System;
(7) Data & Power Supply Cables including Terminations;
(8) Earthing and Lightning Protection Devices;
(9) Installation, Testing and Commissioning Materials; and
(10) Any other item required to complete the scope of the works.

9.3 System Requirements

9.3.1 The Master Clock System shall be based on a 'Central Master Clock', which shall be synchronised to 'Universal Time Co-ordinated' (UTC) by Radio Signals transmitted via the US Department of Defence's 'Global Positioning System' (GPS) Real Time Navigation Satellites.

9.3.2 A GPS Receiver at OCC/Control Location shall receive the Time Source through a Rooftop Antenna from the satellites of the GPS.

9.3.3 The Time Source shall be sent to a Central Master Clock Unit which shall convert the Time Source to synchronization pulses for the use of the slave clock units. The Central Master Clock Unit shall also distribute the time information to Sub-Master Clocks using NTP by an Ethernet Interface to the Optical Fibre Communication System.

9.3.4 At OCC, Station, Depot and Office, a Sub-Master Clock Unit shall receive the time information from the Central Master Clock and shall convert it into synchronization pulses for the slave clock units at those locations.

9.3.5 Slave Clocks shall be connected to the Central Master Clock Unit and the Sub-Master Clock Units. Slave Clocks Schedule is as below:

SN	OCC/Station/Depot	OCC Theatre/SM Room/ Depot Control Room		Building
		Digital	Analogue	Digital
1	Deen Dayal Upadhyay	1	1	6
2	New Ahraura Road	1	1	6
3	New Dagmagpur	1	1	6
4	New Mirjapur	1	1	6
5	New Unchdih	1	1	6
6	New Karchana Jn.	1	1	6
7	New Manauri	1	1	6
8	New Sujatpur	1	1	6
9	New Rasulabad	1	1	6
10	New Malwan	1	1	6
11	New Kanpur	1	1	6
12	New Bhimsen	1	1	6
13	IMD Deen Dayal Upadhyay	1	1	8
14	IMSD New Dagmagpur	0	0	4
15	IMSD New Unchdih	0	0	4
16	IMD New Karchana	1	1	8
17	IMSD New Manauri	0	0	4
18	IMSD New Rasulabad	0	0	4
19	IMSD New Malwan	0	0	4
20	IMD New Kanpur	1	1	8
21	OCC	2	2	10

9.3.6 The Slave Clocks shall be of analogue or digital types. The clock face design shall ensure that these clock units shall provide good visibility.

9.3.7 Each of the Systems/Sub-system that require Synchronized Time Information shall be connected to the OCC or Station LANs and shall obtain the information using NTP from Master Clock System.

9.4 Performance Specifications

9.4.1 General

9.4.1.1 In addition to what has been specified in Chapter 3, the following performance requirements for the Master Clock System shall be complied.

9.4.1.2 Fault tolerant design with protections against failure shall be provided in order to achieve the system availability. Protections shall include, but not be limited to path diversity, redundancy and duplication of reliability critical equipment, component and circuits.

9.4.2 Reliability

9.4.2.1 The inability to perform any required function, the occurrence of unexpected action or the degradation of performance below the specifications shall be considered as a failure.

9.4.2.2 The Contractor shall furnish to the Engineer the reliability figures i.e. MTBF Hours from the OEMs of the following sub-systems/equipment:

(1) Master Clock;
(2) Sub-Master Clock; and
(3) GPS Receiver.

9.4.3 Availability Requirements

9.4.3.1 The Contractor shall implement a RAMS Plan defined in accordance with IEC 62278. The Contractor shall submit to the Engineer for review the RAMS analysis for the Master Clock System to establish the requirements of availability specified herein below.

9.4.3.2 The Master Clock System shall be considered unavailable if the clock signal is not available at any location or the accuracy of the clock signal is below the specification. The availability of the Master Clock equipment shall be better than 99.99%.

9.4.4 Maintainability Requirements

9.4.4.1 The Contractor shall comply with the maintainability requirements as specified in Clause 3

9.4.4.2 The service life of the Master Clock System shall not be less than 15 years.

9.4.5 System Safety Requirements

9.4.5.1 All equipment shall comply with, and be installed in conformance with IEC 60065 and IEC 60364 or equivalent National Electric Code/Uniform Building Code of safety standards.

9.4.5.2 All metallic enclosures shall be provided with an earth terminal which shall be connected to Earth.

9.5 Technical Requirements

9.5.1 Central Master Clock

9.5.1.1 The Central Master Clock shall consist of Redundant GPS Receivers which shall continuously collect the external time information, e.g. Universal Coordinated Time (UTC) and derive Indian Standard Time by offsetting as required.

9.5.1.2 The GPS receiver shall not suffer from the GPS week counter rollover problems, which cause the week counter to reset to zero every 1024 weeks.

9.5.1.3 To protect the Master Clock equipment from lightning, surge protectors shall be provided to connect from the GPS antenna to the ground to safely shunt potentially damaging voltage on the antenna to the ground.

9.5.1.4 The Central Master Clock shall consist of Redundant Master Clock Units. The Master Clock Units shall detect the absence or corruption of the UTC time standard signal and give an alarm if either of these occurs. Bad data resulting from a satellite malfunction, temporary reception problems or an erroneous upload to satellite is not used. Errant timing that causes errors in the timing system shall be avoided.

9.5.1.5 The Master Clock Units shall have their own oscillator and be able to maintain accurate time with an accuracy of 30 milliseconds w.r.t. GPS Reference for duration of 24 Hours of loss of time synchronization with GPS.

9.5.1.6 The status of the Master Clock System including GPS Receiving System, Master Clock Unit, Clock Distribution System, Sub Master Clocks and the NTP Servers shall be monitored by the OFC Communication NMS or a dedicated Clock Management System.

9.5.1.7 The Master Clock Units shall be self-correcting in the event the synchronization from the GPS is lost and re-established.

9.5.1.8 The Central Master Clock Units shall support connectivity of Ethernet TCP/IP Network, RS485 and RS232 as required.

9.5.1.9 The Master Clock Units shall include Network Time Server to provide NTP timing for other interfacing Systems/Subsystems connected to the OCC/Stations/Depot/Office LANs. The type and quantities of the interfaces shall be determined by the interface requirements of the Subsystems under this Contract and relevant Interfacing Project Contractors. Network Time Synchronization over the Data Network using NTP shall be with an accuracy of ±0.01 seconds per 24 hours.

9.5.1.10 Audio and Visual Alarm outputs shall be provided to indicate loss of Time Synchronization or Power.

9.5.1.11 Outages of power supply of normal duration to the system shall have no significant impact on the accuracy of the system time.

9.5.1.12 The Clock Management System shall provide full configuration support for Master Clock units and Sub Master Clocks.

9.5.2 Sub Master Clock

9.5.2.1 The Sub-Master Clock at Station shall be synchronized by the Central Master Clock over NTP. It shall be possible for Sub-Master Clock to work both as NTP Server and NTP Client.

9.5.2.2 The Sub-Master Clock shall be able to detect the absence or abnormality of the synchronized time signal from the Central Master Clock. The Sub-Master Clocks shall have its own internal clock and be able to maintain time with a minimum accuracy of 1s a day when they do not receive signals from the Central Master Clock. On restoration of the Master Clock Signal, the Sub-Master Clock shall validate the signal and after successful validation the Sub-Master Clock shall self-correct if necessary.

9.5.2.3 Local Display of the time shall be provided. Display shall include hours and minutes.

9.5.3 Display Clocks

9.5.3.1 All display clocks shall be synchronized by the Central Master Clock Unit//Sub-Master Clocks. The slave clock shall be able to free run from local quartz oscillators with drift of one second per day in the absence of communication link or synchronisation sources.

9.5.3.2 Analogue Slave Clocks for indoor use shall be single sided with minimum dial diameter of 30 cm, with minimum viewing distance of 30 metre.

9.5.3.3 Digital Slave Clocks for indoor use shall be 7 Segments LED type with minimum digit height of 57 mm, with minimum viewing distance of 20 meter.

9.5.3.4 The displayed time of all display clocks shall be hours and minutes.

9.5.3.5 The display shall be clear under relevant, frequently occurring lighting conditions, including direct sunlight (from behind and in front) and when there are any reflections in the clock faces.

9.5.3.6 The optical characteristics of the transparent display cover shall be selected such that the light transmission and display contrast are suitable for the environment in which the clocks are installed.

9.5.3.7 Subject to the architectural constraints for each specific location, the clocks shall either be wall mounted or ceiling mounted or pole mounted. The Contractor shall determine the mounting method and submit to the Engineer for review before installation.

9.5.3.8 The Slave Clocks shall be manufactured to be used in non-air-conditioned environment with high humidity exposure.

9.5.3.9 The Master Clock System shall be capable of working from 230 Volts +/- 10% AC 50 Hz Power Supply.

9.5.4 Clock Management System

9.5.4.1 The status of the Master Clock Systems including GPS Receiving System, Master Clock Units, Clock Distribution System, NTP Servers, Sub-Master Clocks and Slave Clocks shall be monitored using SNMP by proposed dedicated Clock Management System to be provided at OCC.

9.5.4.2 The Clock Management System shall provide full configuration support for Master Clock Units and Sub-Master Clocks.

9.5.5 Antenna System

9.5.5.1 Surge protector shall be provided to shunt potentially damaging voltages on antenna coaxial to ground.

9.5.5.2 The system shall be weather proof. It shall be tolerant to direct sunlight, wind, rain and other sources of water.

9.5.5.3 The antenna shall be mounted at appropriate location to be identified during Definitive Design Surge Protector shall be provided between Antenna and Central Master Clock Units.

9.6 System Expansion

9.6.1 The Master Clock System shall be equipped with capacity to provide clock signal and timing reference distribution to 50 additional locations for other System/Subsystem or Sub Master Clocks.

9.6.2 The system shall be able to support the required number of display clocks plus at least 10 additional Slave Clocks at each location.

∗ End of Chapter 9 ∗

CHAPTER 10 - VHF COMMUNICATION SYSTEM

10.1 25 Watt VHF Transceivers

10.1.1 General

10.1.1.1 Specifications given below shall be read in conjunction with RDSO Specification No. RDSO/SPN/TC/73/2008.

10.1.1.2 VHF Communication System shall be created at Stations using 25 Watt VHF Transceivers. VHF Transceivers along with Power Supply and Associated Accessories & Cables shall be supplied by the Contractor.

10.1.1.3 25 Watt VHF Transceivers shall be installed in Station Control Room and any other specified place as decided by the Engineer. Omni-Directional Antenna for 25 Watt VHF Transceivers shall be mounted on a suitable Pole/Mast at a height of 15 meters from the ground level. Omni-Directional Antenna and Pole/Mast shall be supplied by the Contractor.

10.1.1.4 Provision of Voice Recording of conversation taking place on 25 Watt VHF Transceivers shall be provided through Voice Recording Equipment. This recording shall be Date and Time Stamped along with Stamping of Station Identity and VHF Channel Identity. Storage of Voice Communication shall follow FIFO (First-In-First-Out) methodology. Once voice communication is stored, it shall not get corrupted in any way. There shall not be any compression of the Voice Signals. The capacity of Voice Storage shall be at least 4 -weeks. There shall be an Ethernet Interface Port through which Recorded Voice can be transferred to Laptop for replay or taking backup on CD/DVD. It shall be able to replay the Voice Recordings by simple operation of some feature/function key.

10.1.1.5 48 V DC Battery Backup System under Chapter-11 shall be used as a Power Source for these 25 Watt VHF sets.

10.1.1.6 Device for protection of 25 watt VHF Transceivers base station shall be provided in accordance with RDSO Specification No. RDSO/SPN/TC/98/2011 for Surge Protective Devices for Telecommunication Equipment Specification of 25 Watt VHF Transceivers shall be as given below:

General		
1.	Frequency Range	136 -174 MHz
2.	No. of Channels	16 Channels or more
3.	Channel Spacing	12.5 KHz or 25 KHz
4.	Frequency spread	5 MHZ or more without degradation in Tx/Rx specifications.
5.	Frequency Stability	5 PPM or better
6.	Type of Emission	11 KOF3, 8K5OF3E or 16KOF3E
7.	Type of Operation	Simplex/Semi Duplex, press to talk with built in condenser microphone and the speaker.
8.	Type of Antenna	Stacked Dipole Omni directional antenna complete with cable and other accessories.
9.	Speaker Impedance	To be specified by the firms at internal External speaker point.
10.	Speaker	Internal Speaker as well as Socket for External Speaker shall be provided

		(The Internal Speaker shall be cut-off when External Speaker is used).
11.	Output Impedance	and the Aerial Terminal should have VHF Female Socket.
12	Protection	Reverse Polarity protection shall be provided. The final transistor shall be protected against high VSWR
Transmitter		
1.	RF Power output	25W +/- 0.5 dB
2.	Frequency Deviation	Max. (For 100% at 1 KHz) for 12.5 KHz channel spacing
3.	Modulation Sensitivity	1 to 10mV at 1 KHz at mic input for +-1.5 KHz (for 12.5 KHz channel spacing) standard deviation
4.	Modulation Distortion	Less than 5% at 1 KHz reference +/-1.5 KHz (for 12.5 KHz channel spacing) Standard deviation.
5.	Modulation Fidelity	+1, -3 dB of 6 dB/Octave pre-emphasis Characteristics from 300 Hz to 2700 Hz. With 1 KHz as references.
6.	Spurious & Harmonics Supersession	Better than 60 dB
Receiver		
1.	Sensitivity	0.30µV/-118 dBm at 12 dB SINAD
2.	Squelch Sensitivity	Better than -119 dBm
3.	Selectivity	Better than 60 dB
4.	Image and Spurious Rejection	Better than 65 dB
5.	Audio Output	1W with less than 5% distortion at 1 KHz reference measured at specified audio frequency output.
6.	Audio Frequency Response	Within +1, -3dB of 6dB/Octave
Feature-wise Configurations		
1.	Simple press to talk	
2.	Protection against high VSWR	
3.	Channel spacing (12.5KHz) or 25 KHz	
4.	PTT ID Encode	

5.	CTCSS/DCS Signalling alongwith Inverse Scrambling
6.	Busy Channel Lockout
7.	Channel scanning with call quieting facility
8.	DTMF/ Signalling with Selective Calling
9.	Selective Call Decode.
10.	Capable of being killed/Unkilled.

10.2 5 Watt VHF Walkie-Talkie Sets

10.2.1 The Contractor shall supply 200 Nos. 5 Watt VHF Walkie-Talkie Sets complete with their standard OEM Battery Packs, Carrying Case and Charger.

10.2.2 The Contractor shall also supply 15 Nos. Multi-Unit Charger (for charging minimum 5 units) for charging of 5 Watt VHF Walkie-Talkie Sets. The Charger shall be Rapid Battery Charger.

10.2.3 The 5 Watt Walkie Talkie equipment shall be provided as per the following specification or better:

General		
1.	Frequency Range	134-174 MHz (Full Band)
2.	No. of Channels	16 Channels or more
3.	Channel Spacing	12.5 KHz or 25 KHz
4.	Frequency spread	5 MHZ or more without degradation in Tx/Rx specifications
5.	Frequency Stability	5 PPM or better
6.	Type of Emission	11 KOF3
7.	Type of Operation	Simplex/Semi-duplex, press to talk with built in condenser microphone and speaker
8.	Type of Antenna	Helical Antenna suitable for Frequency Range specified.
9.	Speaker Impedance	To be specified by the firms at internal external speaker point
10.	Speaker	Internal Speaker as well as Socket for External Speaker shall be provided (The Internal Speaker shall be cut-off when External Speaker is used).
11.	Output Impedance	50 Ohms and the Aerial Terminal should have VHF Female Socket.
12	Protection	(i) Reverse Polarity protection shall be provided. (ii) The final transistor shall be protected against high VSWR
13.	Power Source	2000 mAH 7.2-7.4 V, NiMH or Li-Ion Battery.

14.	Weight	600 g Maximum with Battery.
Transmitter		
1.	RF Power output	1-5 Watt RF power output switch able/ programmable
2.	Frequency Deviation	+/- 2.5 KHz Max. (For 100% at 1 KHz) for 12.5 KHz channel spacing.
3.	Modulation Sensitivity	1 to 10mV at 1 KHz at mic input for +/- 1.5 KHz (for 12.5 KHz channel spacing) standard deviation
4.	Modulation Distortion	Less than 5% at 1 KHz reference +/-1.5 KHz (for 12.5 KHz channel spacing) Standard deviation.
5.	Modulation Fidelity	+1, -3 db of 6 dB/Octave pre-emphasis characteristics from 300 Hz to 2700 Hz. With 1 KHz as reference.
6.	Spurious & Harmonics supersession	Better than 60
7.	VSWR	Less than 1.5
Receiver		
1.	Sensitivity	0.3µV/-118 dBm at 12 dB SINAD
2.	Squelch Sensitivity	0.25 micro V or better at threshold.
3.	Selectivity	Better than 60 dB
4.	Image Rejection	Better than 65 dB
5.	Audio Output	Better than 250mW with less than 5% distortion at 1 KHz reference measured at specified AF output.
6.	Audio Frequency Response	Within +1, -3 dB of 6dB/ Octave
Feature-wise Configurations		
1.	Simple Press-to-Talk	
2.	Protection against high VSWR	
3.	Low Battery Alert	
4.	Capable of VOX for Hands-free Operation.	
5.	PTT ID Encode	
6.	CTCSS/DCS along with Inverse Scrambling	
7.	Busy Channel Lockout	

8.	Channel Scanning with Call Quieting facility
9.	DTMF Signalling with Selective Calling
10.	Selective Call Decode.
11.	Capable of being killed/Unkilled.

10.3 General Requirements

10.3.1 All equipment shall be suitable for operation in the following environmental conditions.

Operating Temperature Range : -5° C to +55° C

Storage Temperature Range : -10° C to +70° C

Relative Humidity : 95% Max +40° C non condensing.

Environmental Test Reports in respect of main equipment of 25 Watt VHF Transceivers and 5 Watt VHF Walkie-Talkie Sets proposed to be supplied shall be submitted along with Design Submissions for review by the Engineer. Environmental conditions prevailing in the section where it is to be deployed have been listed in GS – Part 2, Section VI,Volume 1. The Contractor shall submit the Environmental Test Reports to the Engineer for review.

S No	**Test**	**Conditions of test to be conducted as per ISO-9000**	
a)	Dry Test	Part-III/SEC.5/1977	55^{o} C(+/-) 2^{o} C. RH<50% Duration 16 Hr.
b)	Dump Heat (Cyclic) Test	Part-V/SEC.2/Variant1/1981	40^{o}C(+/-) 2^{o} C, RH 95%. Two cycles of 24 (12+12) hrs each.
c)	Cold Test	Part-II/SEC. 4/1977	(-)10^{o} C +/-3^{o} C, Duration 16 Hrs.
d)	Drop test (in packed	Part-VII/SEC.3/1979	Six drops one on each face, Height of all 1000mm in case of hand held items and 500mm in case of 0ther items.
e)	Vibration Test	Part VIII/1981	12 Hrs, 4 hours along each axis, at 15-150 Hz and with amplitude of 0.15 mm/2g
f)	Storage Test	Part III/SEC.5/1977 & Part II/SEC.4/1977	-10^{o} C for 5 hours. Then raise the temperature to 70^{o} C for 16 hrs.
g)	Bump test	Part VII/SEC.2/1979	4000 bumps at peak acceleration of 400m/s.sq.

10.3.2 Environmental Test Report with equivalent or superior conditions would be acceptable.

10.3.3 In case of Transceivers, the functional tests shall be carried out at the commencement and at the conclusion of the environmental test sequence as above. The functional tests and permissible degradation shall be as under:

(1) RF Power output : It shall not degrade by more than 1 dB

(2) Receiver Sensitivity : It shall not degrade by more than 1 dB
(3) Frequency Stability : No degradation shall be noticed on any frequency.

10.3.4 In the case of batteries, battery chargers and power supplies, the functional tests shall be carried out at the conclusion of the environmental test sequence as above. The functional tests and permissible degradation shall be as under:

(1) Battery: No degradation in battery capacity
(2) Battery Charger: No degradation in output voltage.
(3) Power Supplies: No degradation in output Voltage.

*** End of chapter 10 ***

CHAPTER 11 - 48 V DC BATTERY BACKUP SYSTEM REQUIREMENTS

11.1 General

11.1.1 The 48 V DC Battery Backup System at each TER, shall be sized to power its full load including, but not limited to, Mobile Train Radio System, VHF Communication System, Telephone System,, Data Networking System and OFC System. The VHF Communication System shall work on 12 V DC.

11.1.2 230 V AC Power Supply for 48 V DC Battery Backup System shall be provided as detailed in Clause 12.3.4 of this Particular Specification.

11.1.3 The Battery Backup System shall include Line Protecting Devices, Battery Chargers, Battery Banks and Load Distribution Arrangement. The Battery Banks shall consist of Valve Regulated Lead Acid Maintenance Free Cells.

11.2 Design Requirements

11.2.1 Design shall take into consideration the voltage drop between the Power Supply Source and the Telecommunication System Load individually at each location (OCC, Stations, Auto Signal Locations, GSM-R Locations etc.).

11.2.2 Provision of suitable Earth Leakage Detector and Alarms shall be made individually at each location (OCC, Stations, Auto Location Huts, GSM-R Locations, LC Gate Locations, etc.).

11.3 Technical Requirements

11.3.1 For high availability, the Battery Backup System at each location shall include 2x100% SMPS based 48 V Battery Chargers in Load Sharing Mode with individual 48 V Battery Bank for each Battery Charger.

11.3.2 Each of the two Battery Banks shall provide busy hour reserve of four(4) hours, for all Telecommunication Equipment powered by 48 V DC Battery Backup System, at each location (OCC, Station, Auto Signal Location, LC Gate Location, etc.).

11.3.3 For sizing the battery capacity at each location, relevant factors like K Factor (as applicable), Ageing Factor (1.25), Design Margin (1.1), Temperature Factor and ECV (as applicable for the type of battery) shall be considered. In addition spare capacity of 25% shall be provided to cater for any requirement of additional equipment at that location.

11.3.4 Battery Chargers shall be as per RDSO Specifications RDSO/SPN/TL/23/99 Version 4.0 with Latest Amendments. Each Charger system shall be sized to meet full load as mentioned above and simultaneously charge the fully discharged Battery Bank connected to it at 10 Hour Rate of Charge for the battery. The Battery Chargers shall be procured from RDSO Approved Sources only. The design shall ensure that the failure of a single component does not cause failure of the 48 V DC Battery Backup System.

11.3.5 All Battery Cells shall be of the Valve Regulated Lead Acid Maintenance Free type to RDSO specifications IRS S93-96 with Latest Amendments for capacities up to and including 500 AH and to TEC Specifications No.GR/BAT-01/03 March 2004, DOT specifications No.TQ.510G 92 with Latest Amendments for capacities beyond 500 AH. The life of these Battery Cells shall not be less than 7 years.

11.3.6 There shall be no break in the 48 V DC Power Supply to the Telecommunication Systems during failure of one of the Battery Charger with Battery Bank.

11.3.7 The following data shall apply to 48 V DC Battery Backup System:

(1) Input Voltage Range (Single phase): 230 V AC (+10 %, - 20%)
(2) Input frequency: 50 Hz +/- 5%

(3) Output Current: As required for each location

11.3.8 Battery Backup System functions shall include:

(1) Low Voltage Battery Disconnection (LVD)
(2) Battery Disconnection Pre-Alarm
(3) Battery Current Limiting
(4) Temperature Compensated Charging
(5) Test Mode Facility
(6) System control functions shall include-
    1. Float/ charge mode facility.
    2. Auto/Manual Switch for boost charging.

11.3.9 System Protection shall include

(1) High Voltage Input Disconnection (HVD)
(2) Lightning Protection/Surge Protection
(3) Transient Absorbers for Component Protection
(4) Load Fuses/MCB's as required
(5) Battery Fuses /MCB's as required

11.3.10 Alarms for the Battery Backup System shall be implemented through Network Management System (NMS) provided in EDFC Phase-1 in the TER at OCC.. Contractor shall extend these alarms using appropriate interface such as RS-232, RS-485, TCP/IP etc. Following Alarms shall be provided on the NMS in the TER at OCC for each of the 48 V DC Battery Backup System at all locations.

(1) Mains Available/Mains Not Available
(2) Mains Out of Range
(3) Float Mode
(4) Charge Mode
(5) System Overload
(6) Rectifier Modules Fail (one or more than one)
(7) Battery Cut-Off Pre-Alarm
(8) Battery Fail/Isolated
(9) Over temperature
(10) Summary Alarm
(11) Operation OK
(12) Input Voltage High
(13) Boost Mode
(14) Mains Low
(15) Mains Fail

11.3.11 SystemExpansion

The Battery Backup system shall be designed and equipped with all necessary hardware, software and capacity for future 25 % Additional Load. All the components like Transformers, Batteries, Cables etc. shall as a minimum cater to 25% Spare Capacity.

∗ End of Chapter 11 ∗

CHAPTER 12 - INSTALLATION, EARTHING, LIGHTNING AND SURGE PROTECTION

12.1 General

12.1.1 The Contractor shall supervise all installation of the Works and shall ensure all technical, safety and quality matters adhered to the Design reviewed by the Engineer.

12.1.2 The Contractor shall take every precaution to protect existing equipment and facilities on Site from damage, and shall make good any damage caused. Care shall also be taken not to interfere with the operation of existing equipment.

12.1.3 The Contractor shall provide all necessary and sufficient resources such as tools, test instruments, spares, equipment , manpower and communication facilities to complete all the installation activities.

12.1.4 The Contractor shall ensure his staff are competent and possess all the necessary skills to carry out the installation in a proper and safe manner.

12.1.5 The Contractor shall carry out site surveys to ensure sufficient knowledge on the Site before submitting the relevant installation design & drawings and other installation related submissions to the Engineer for review.

12.1.6 The Contractor shall submit calculations, if required, by the Engineer to demonstrate that the proposed mounting methods are sufficient to withstand the wind loading for the equipment. All submitted calculations shall be undertaken and certified by relevant Registered Structural Engineer

12.1.7 The Contractor shall submit installation method statements for each type of installation activities at least three months before the commencement of the activity to the Engineer for review.

12.1.8 The installation method statement shall include the details on the methods and procedures of installation, site arrangement, manpower resources, equipment and tools required. Drawings shall be included to illustrate the proposed installation details.

12.1.9 All installation activities shall commence only after the method statement and related submissions have been reviewed without objection by the Engineer.

12.1.10 The Contractor shall assign competent site supervisors for each work site to be responsible for all site-related matters.

12.1.11 The Contractor shall carry out regular site audit on both technical and safety matters and maintain records of the site audits. The Contractor shall make these records available to the Engineer for inspection upon request.

12.2 Installation Programme

12.2.1 The Contractor shall submit the Installation Programme for review by the Engineer. This Installation Programme shall take into account the following:

(1) Installation schedule
(2) Milestones
(3) Site Access
(4) Interfacing with relevant Project Contractors
(5) Interfacing with Indian Railway at the junction stations.

12.2.2 The Contractor shall co-ordinate with relevant Project Contractors to agree the date of access to the physical areas to carry out installation activities.

12.2.3 The Contractor shall highlight in his Installation Programme any items, materials, equipment, resources and supports to be provided by the Engineer with dates, duration and location.

12.2.4 The Contractor shall highlight in his Installation Programme all relevant constraints, which may affect the Installation Programme, for the Engineer's attention.

12.2.5 The Contractor shall include dependencies between relevant activities in the Installation Programme.

12.2.6 The Contractor shall ensure sufficient floats or slacks in all activities and avoid critical paths built in his Installation Programme. In case critical paths cannot be avoided, the Contractor shall take adequate measures to complete all critical paths activities in time and also highlight these critical paths for the Engineer's attention.

12.2.7 The Contractor shall propose contingency plan to ensure all the milestones can be met in case there is slippage in the installation activities.

12.2.8 Any subsequent changes in the reviewed Installation Programme shall be submitted to the Engineer for review.

12.3 Installation Works in Equipment Rooms

12.3.1 Telecommunication Equipment Room at Stations, IMDs, IMSDs, Residential Colonies, Club/Institute and Guest House will be constructed by CST Contractor to install the Telecommunication Equipment.

12.3.2 Telecom Power Supply Equipment Rooms at Stations, IMDs, IMSDs, Residential Colonies, Club/Institute and Guest House will be constructed by CST Contractor to install the Telecom Power Supply Equipment.

12.3.3 Telecommunication Equipment Room/Telecom Power Supply Equipment Room at Auto Location Huts, Interfacing IR Stations, GSM-R Locations, TSSs, SPs, SSPs and any other location as required shall be constructed by Contractor as stipulated in Particular Specifications-Building & Structure Works. These rooms shall be preferably be co-located with the Signalling Equipment Room/Signalling Power Supply Equipment Room. At these co-located locations a common S&T Power Supply Equipment Room for housing Signalling Power Supply Equipment as well as Telecom Power Supply Equipment shall be provided with the approval of the Engineer.

12.3.4 Electric Power for Telecom System up to Main AC Distribution Panel common for Signalling & Telecom Systems shall be drawn as covered in Clause 5.3.10 of Particular Specification for Signalling Works. From this Main AC Distribution Panel, electric power for Telecom System shall be taken to Telecom AC Distribution Panel for distribution to Telecom Power Supply Equipment and Telecom Equipment.

12.3.5 For exact room dimensions the Contractor shall co-ordinate and refer to the final Station Building Plans for Telecom Equipment Rooms and Telecom Power Supply Equipment Rooms at Stations and Tele Huts for installing the Telecom Equipments and Telecom Power Supply Equipments.

12.3.6 48V DC Power Supply from 48 V DC Battery Backup System shall be taken to DC Distribution Panel for further distribution to Telecom Equipment.

12.3.7 Provision of Lighting, Power Outlets, Fans, Ventilator and Air-Circulation shall be made in accordance with Interface Requirements as mentioned in Appendix 3 of General Specification.

12.3.8 All floor-mounted equipment cabinets at the equipment rooms shall be securely bolted to floor/ground, properly aligned and levelled.

12.3.9 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 is of sufficient strength to hold the wall-mounted equipment in a secure and safe manner.

12.3.10 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.

12.3.11 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.

12.3.12 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.

12.3.13 All optical cable fibres which run outside shall be contained in protective conduits.

12.3.14 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.

12.3.15 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:

(1) drawings showing the equipment layouts and positions of the racks, cabinets and enclosures;

(2) racks, cabinets layout drawings showing the arrangement of individual module;

(3) specifications, sample of all the mounting brackets and accessories;

(4) equipment mounting and installation methods;

(5) schematic diagrams and wiring diagrams of the System;

(6) electrical distribution schematics within each equipment room including the earthing details; and

(7) Cable route diagrams for cables within each equipment room.

12.3.16 Installation works inside the equipment rooms shall be carried only after these submissions have been reviewed without objection by the Engineer.

12.4 Installation Works within Buildings

12.4.1 The Contractor shall provide all necessary mounting brackets and accessories for installation of all indoor Telecommunication Equipment as covered in this Particular Specification.

12.4.2 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.

12.4.3 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%.

12.4.4 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.

12.4.5 The Contractor shall submit the following to the Engineer for review at least three months before the commencement of the installation activities:

(1) specifications, sample of all the mounting brackets and accessories;

(2) equipment mounting and installation methods;

(3) schematic diagrams and wiring diagrams of the System;

(4) cable trays/trunks/conduits route plan within building showing cross-sectional occupancy; and

(5) Cable route diagrams for cable within buildings.

12.4.6 Installation works within the building shall be carried only after these submissions have been reviewed without objection by the Engineer.

12.5 Outdoor Installation Works

12.5.1 The Contractor shall provide all necessary mounting brackets and accessories for installation of all outdoor Telecommunication equipment as covered in this Particular Specification.

12.5.2 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.

12.5.3 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.

12.5.4 The Contractor shall submit the following to the Engineer for review at least three months before the commencement of the installation activities:

(1) specifications, sample of all the mounting brackets and accessories;
(2) equipment mounting and installation methods; and
(3) Schematic diagrams and wiring diagrams of the System.

12.5.5 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.

12.5.6 All trackside equipment and the mounting method shall be designed in the way to minimise the frequency of preventive maintenance.

12.6 Cab Radio Installation

12.6.1 Cab Radio to be installed in rolling stocks shall be identified by Engineer and informed to Contractor during Design Stage.

12.6.2 The mounting of the Cab Radio and its sub-assemblies shall be designed to facilitate ease of maintenance.

12.6.3 All cabling and termination shall adopt standard wiring practice.

12.6.4 Cab Radio installation shall be rugged and capable of withstanding vibrations expected in such type of EMUs. Information on expected level of vibration may be obtained from the Engineer. The installation shall comply with EN61373, EN50155, EN 50121-3-2),

12.6.5 The Contractor shall submit the following to the Engineer for review at least 3 months before the commencement of Cab Radio installation in the rolling stocks:

(1) Drawings showing equipment layout, racks, cabinets and enclosures. This shall include the mounting arrangement of the antenna on the rolling stocks. Racks & Cabinet layout drawings showing the arrangements of individual modules;

(2) Schematic diagrams and wiring diagrams of the System;
(3) Electric power requirements, wiring and earthing arrangements; and

(4) Inter cab cabling arrangements;

12.6.6 Installation Works in the cabs and inter cab wiring shall be carried out after the submissions have been reviewed without objection by the Engineer.

12.7 Cabling

12.7.1 All Outdoor Cables (Optical Fibre Cable inside HDPE Duct, Jelly Filled Telecom Quad Cable & PIJF Telephone Cables) shall be laid with in DFCC boundary and as far away from the track as possible. If it is necessary to lay cable outside the DFCC boundary, permission shall be obtained in advance from the concerned authority. It shall also be ensured that Jelly Filled Telecom Quad Cable and PIJF Telephone Cables shall not be laid between EDFC Track and Indian Railway Track.

12.7.2 The Contractor shall prepare a Cable Route Plan in consultation with Civil/Track Contractor and get it approved from the Engineer before starting the trenching work. Instructions of Railway Board in this connection shall be followed.

12.7.3 All Ducts/Troughs/Trenches for outdoor cable laying, except at Concrete Bridges & Culverts, shall be provided by the Contractor.

12.7.4 Outdoor Cables in trench shall be laid as per Chapter XIII of Indian Railway Telecommunication Manual. 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 suitably protected with bricks. If it is inescapable in some sections to have both trenches (for Optical Fibre Cable route diversity) at same side of DFCC Track, one trench which is farthest from DFCC Track shall be of 1.7 meter depth from the natural earth profile.

12.7.5 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.

12.7.6 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.

12.7.7 Outdoor Cables in rocky areas shall be laid as per Chapter XIII of Indian Railway Telecommunication Manual.

12.7.8 On Concrete Bridges &Culverts, duct on the both side of Railway Tracks will be provided by Civil Structure & Track Contractor for laying of cables. All Outdoor Telecommunication Cables (Optical Fibre Cable inside HDPE Duct, Jelly Filled Telecom Quad Cable & PIJF Telephone Cables) on these Concrete Bridges & Culverts shall be laid inside DWC Pipes. Entry/Exit of the Cables to/from Bridges & Culverts shall be suitably protected as approved by the Engineer. The Contractor shall carry out necessary co-ordination with Civil, Structure & Track Contractor in this matter.

12.7.9 Cable laid in the slope of track formation shall be laid Double Wall Corrugated Pipes. 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.

12.7.10 Following principles for laying of cables shall be adopted during Track/Road Crossings.

(1) The cable crosses the track/road at right angles.
(2) The cable does not cross the track under points and crossings.
(3) Boring or Trenchless technique shall be used while cable crosses the track/road.
(4) The cable is laid in HDPE Pipe of minimum 6 mm wall thickness/Double Wall Corrugated HDPE pipes while crossing the track/road.

(5) The cables are laid at a depth of 1.2 metre below the normal ground level or rail level, whichever is lower.
(6) Track formation/road surface shall be restored to its original condition after laying of cables.

12.7.11 Optical Fibre Cable shall be laid in Lubricated HDPE pipes. These Permanently Lubricated HDPE Ducts shall be laid from one Telecommunication Equipment Room to other Telecommunication Equipment Rooms Cables shall be laid in DWC pipe through trenchless method while crossing the road or the railway DWC pipe shall have a minimum 6 mm wall thickness. Straight Joints for Optical Fibre Cable shall be as per Chapter XIII of Indian Railway Telecommunication Manual

12.7.12 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.

12.7.13 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.

12.7.14 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.

12.7.15 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.

12.7.16 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:

(1) Remove such laid cable and cut into pieces of scrap of about 2 metres each;
(2) Lay new cable in lieu;

12.7.17 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.

12.7.18 Cables in any trough/duct or tray/trunk/conduits shall not occupy cross-sectional space in excess of 50%.

12.7.19 At no location shall the cable be bent with a radius lower than the minimum radius recommended by the manufacturers. Sharp edges shall be avoided.

12.7.20 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.

12.7.21 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.

12.7.22 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.

12.7.23 Unused cable cores/pairs of multi-core/pair cables shall also be terminated and marked so.

12.7.24 Underground Cable Route shall be identified by Electronic Cable Markers directly buried inside the trench with the approval of the Engineer.

12.7.25 The Contractor shall ensure that the maximum length of parallelism is suitable to the requirement of 25 KV AC AT Feeding Traction of DFCC and 25 KV AC Traction 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.

12.7.26 The Outdoor Cables (Jelly Filled Telecom Quad Cable & PIJF Telephone Cables) 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. Such coils of cables in pits shall be adequately covered to provide protection against damage and theft.

12.7.27 All the cable entry into TER/Location Boxes etc. shall be suitably sealed to prevent entry of rodents etc.

12.7.28 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 and be willing to guarantee 25 years or more of service life for all the cables

12.7.29 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.

12.7.30 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.

12.7.31 HDPE Duct (Sr. No. 20 of Addendum No. 8, Page No. 0035)

(1) 40/33 mm HDPE Duct conforming to TEC GR No. GR/TX/CDS-008/03/March 11 with latest amendment shall be used.

(2) The Duct shall be bright Yellow in colour. The Duct shall be supplied in length of 1000+/- 100 maters.

(3) Every meter of the Duct shall be marked, in ‘Indelible black Ink’, with the following (size of lettering 6-8 mm):

a) DFCCIL

b) PLBE HDPE Duct 40/33 mm

c) Date/Month/Year of production

d) Name of the Manufacturing firm.”

12.7.32 Each fibre splice shall be tested to ensure correct fibre continuity and splice loss.

12.8 Identification

12.8.1 Descriptive labels shall be provided for all cabinets, enclosures, panels, assemblies and sub-assemblies.

12.8.2 Labels shall be of engraved type, with durable markings and shall have character size not less than 6 mm high.

12.8.3 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.

12.8.4 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.

12.8.5 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.

12.8.6 Warning signs shall be provided with graphical symbols and wordings in red for hazardous electrical or optical laser equipment.

12.9 Marshalling and Termination

12.9.1 General

12.9.1.1 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.

12.9.1.2 The signal termination and distribution practice shall adopt a consistent approach for easy circuit identification and is subject to the review of the Engineer.

12.9.1.3 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.

12.9.1.4 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.

12.9.1.5 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.

12.9.1.6 All RF Joints outside the cabinets shall be sealed by waterproof tapes or jackets.

12.9.2 Main Distribution Frame

12.9.2.1 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.

12.9.2.2 The Contractor shall provide at least five sets of the following accessories at each location where the main distribution frame is installed:

(1) tools for circuits connection and disconnection

(2) plug-in devices for circuit disconnection

(3) test cords and loop-back cords

(4) signal patch cords

12.9.2.3 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. For details of Transient Protection refer to Para 12.12.

12.9.2.4 All voice, analogue, alarm and control circuits including spares shall be properly terminated at the main distribution frame.

12.9.2.5 The main distribution frame shall be divided into different zones for different types of circuits.

12.9.2.6 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.

12.9.2.7 The main distribution frame shall be equipped with facilities such as use of different colours or markers to aid circuit pairs identification.

12.9.2.8 The Contractor shall maintain records of all the circuit terminations.

12.9.3 Digital Distribution Frame

12.9.3.1 Digital distribution frame shall be provided at Telecommunication Equipment Room and at other locations as appropriate for data circuit termination.

12.9.3.2 The Contractor shall provide at least five sets of the following accessories at each location where the digital distribution frame is installed:

(1) plug-in devices for circuit disconnection

(2) test cords and loop-back cords

(3) signal patch cords.

12.9.3.3 Different modules in the digital distribution frame shall be provided for different types of data circuits.

12.9.3.4 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.

12.9.3.5 Markers or labels shall be included in the digital distribution frame for easy identification of the circuits.

12.9.4 Optical Distribution Frame

12.9.4.1 Optical distribution frame shall be provided at Telecommunication Equipment Room, and at other locations as appropriate for optical signal distribution. Distribution frame shall comprise of equipment cabinet(s) or enclosures housing,

(1) fibre splice module

(2) fibre storage panel

(3) optical patch panel

12.9.4.2 All fibre cores terminating in the optical distribution frame shall be spliced to factory manufactured pigtails or properly stored in the fibre storage panel.

12.9.4.3 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.

12.9.4.4 Fibre storage panels shall be provided in the optical distribution frame to stow the excess length of pigtail and patch cords.

12.9.4.5 All splices shall be fusion splices and heat shrink splice sleeves shall be used for splice protection and housed in a fibre splice module.

12.9.4.6 All fibre splice modules shall be either telescopic or hinged type for easy access of splice elements.

12.9.4.7 All fibre splice modules shall be equipped with built-in fibre slack take-up mechanism.

12.9.4.8 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.

12.9.4.9 All spare adapters shall be protected with jackets.

12.9.4.10 One high quality optical connector such as LC/FC/PC single mode (SM) 10/125µm 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 0.2dB.

12.9.4.11 All optical connectors shall comply with the ITU-T Recommendation G.652.

12.9.4.12 All pigtails and patch cords shall be properly labelled.

12.9.4.13 The optical distribution frame 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.

12.9.4.14 All optical fibre splice configuration at each location shall be designed to fulfil the System fault tolerant requirement.

12.10 Power Supply Distribution

12.10.1 Electric Power Supply for Telecommunication Equipment is drawn from Main AC Distribution Boards as covered in Particular Specification for Signalling Works.

12.10.2 This 230 V AC Telecom Power Supply from Main AC Distribution Boards shall be taken to Telecommunication AC Distribution Board, from where it shall be distributed to all Telecom Equipment/Telecom Power Supply Equipment operating on 230 V AC. Telecom AC Distribution Board are equipped with MCBs of adequate capacity at Inputs and Outputs.

12.10.3 48 Volt DC Power Supply from 48 V DC Battery Backup System shall be taken to Telecom DC Distribution Board, from where it is distributed to all Telecommunication Equipment operating on 48 V DC. Telecom DC Distribution Board are equipped with MCBs of adequate capacity at Inputs and Outputs.

12.11 Earthing Policy

12.11.1 General

12.11.1.1 Earthing shall be provided for all indoor & outdoor Telecommunication installations to achieve the following objectives:

(1) 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;

(2) to ensure safe & reliable operation of the equipment by limiting or eliminating the induced voltages and transients in the Telecommunication equipment;

(3) 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;

(4) to serve as common voltage reference point wherever required.

12.11.1.2 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.

12.11.1.3 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.

12.11.1.4 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.

12.11.1.5 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.

12.11.1.6 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 radio tower and trains. OEM's original data sheets of the proposed devices shall also be submitted.

12.11.2 Requirements of effective Earthing

12.11.2.1 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.

12.11.2.2 Earthing and other protection devices shall be designed to accomplish the following minimum requirements but not limited to:

(1) protect personnel and equipment from electrical hazards, including lightning and reduce fire hazards;

(2) reduce potential to system neutrals;

(3) enable signalling with earth return;

(4) reduce or eliminate the effects of electrostatic and electromagnetic interference arising from within the EDFC on account of traction voltages, traction return current, electric locomotive characteristics and other extraneous sources;

(5) minimise service interruptions and equipment damage:

(6) minimise radiated and conducted electromagnetic emissions:

(7) reduce radiated and conducted electromagnetic susceptibility:

(8) improve system tolerance to discharge of electrostatic energy and lightning interference:

(9) provide a proper earthing method for all equipment enclosures, cabinets, drawers, assemblies and sub-assemblies; and

(10) provide a clean zero-volt reference point where required.

12.11.2.3 The earthing system shall be so designed as to give earth resistance within the stipulated limits at all locations and under all climatic conditions.

12.11.2.4 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.

12.11.2.5 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.

12.11.2.6 The earthing methods, design and details shall be submitted to the Engineer for review and approval.

12.11.3 Earthing of Indoor Equipment

12.11.3.1 Main earth bus bar shall be provided in the power supply room by the Contractor. The Contractor shall provide minimum 16 mm² cable from the power supply room to the TER and terminate on copper earthing strips of sufficient size and specifications. These earthing strips shall be used by the Signalling Contractor to extend individual earths to cables and racks/equipment etc.

12.11.3.2 In order to ensure a captive earth connection to the cabinets and racks in TER, a minimum cross-section of 16 mm² copper wire shall be used for earthing.

12.11.3.3 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

12.11.3.4 Earthing strips will be connected to a Common Bonding Network (CBN)

12.11.4 Earthing of Outdoor Installations

12.11.4.1 Outdoor installation, listed below, shall be earthed to the nearest Main earth bus bar with a minimum 16 mm² copper conductor:

(1) metallic sheath and armouring of all cables at regular intervals;

(2) location boxes;

(3) racks;

(4) clocks display units; and

(5) Any other Telecommunication installation as may be necessary to cover completem scope of works defined in the Contract.

12.11.4.2 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.

12.11.5 Earthing Arrangement

12.11.5.1 The Contractor shall provide two separate earth connections, a clean earth connection to the earth terminals provided inside the rooms where the Telecommunication equipment is installed, and a main earth connection for the earthing of radio towers, antenna feeder cables, equipment chassis, etc. of the Telecommunication System.

12.11.5.2 The earthing system shall meet, but not be limited to, the following:

(1) The resistance to earth of the system "earth terminal" shall remain within the stipulated limits at all locations and under all climatic conditions.

(2) 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.

12.11.5.3 The earthing arrangements for Antenna Towers and Antennae shall be such that:

(1) The zone of coverage shall afford protection of all objects forming part of the Antenna Towers and Antennae including any objects near the base of the tower, and this factor shall be taken into consideration while deciding the height of the lightning conductor at the top of the tower.

(2) Earthing of VHF/UHF Antenna Feeder Cables having Copper Sheaths shall be such as to maintain a low resistance connection to the earth. Any junction forming a part of this connection shall be protected from ingress of moisture by using proper wrapping, sealing with water-proof tapes, or suchother measures. The connection shall be inspected periodically at intervals frequent enough to ensure that the earth connection meets all the requirements. Earthing kits of approved type shall be used for this purpose.

12.11.5.4 The earthing arrangements for Telecommunication Equipment shall be as below:

(1) All Telecommunication equipment shall be protected using a mesh of copper "earth" strips of appropriate cross-sectional dimensions, forming a local clean earth bus.

(2) 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.

(3) 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.

(4) The earthing connection shall be inspected periodically at intervals frequent enough to ensure that the earth connection meets all the requirements.

12.11.5.5 The metallic sheath and armouring of all cables (RF Cables/Optical Fibre Cable/Others) shall require earthing. In the section earthing shall be done as per the established practices in RE areas of the Indian Railways.

12.11.5.6 The earthing electrodes for the clean earth shall be located at least 20 m away from the main earth.

12.11.5.7 The route for the clean earth shall be so chosen as to minimise the effect of any inductive interference.

12.11.5.8 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.

12.11.5.9 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.

12.11.5.10 All metal work and metallic items shall be earthed to the main earth to ensure the safety of personnel.

12.11.5.11 The earthing methods and details shall be submitted to the Engineer for review.

12.11.5.12 Radio equipment shall be provided with isolated terminations for the connection of coaxial cables extending to equipment in external locations.

12.12 Transient and Lightning Protection

12.12.1 An effective transient protection system, complying to the following as a minimum must be provided to protect the telecommunication equipment from transients-

(1) Peak transients of up to 700 Volts on the DC Power Supply line for several microseconds.

(2) Average transient duration of 2 microseconds with a repetition frequency of 15kHz to100kHz.

(3) For short duration transients (< 5ms) the variation approaches a sinewave

(4) For longer duration transients (> 5ms) the variation approaches rectangular pulses with an initial rate of rise up to 5x10^4 Volts per second.

12.12.2 Suitable electronic devices (such as silicon avalanche suppressor devices/transzorbs) having high surge handling capability, fast response time and low clamping voltage, etc; shall be incorporated in the telecommunication equipment to ensure that the latter withstands the above mentioned conditions without any damage or permanent degradation in performance throughout the system lifetime. The selection criteria for such devices shall include, but not be limited to, the following:

(1) Reverse standoff voltage shall be at least twice the maximum operation voltage;

(2) Pulse power rating shall be adequate to handle the peak pulse power of the transients and ensure their decay in less than 10% of the rise time for the worst pulse likely to be encountered from all possible sources including lightning and transients from overhead traction power system;

(3) Device lifetime shall not be less than that of the system for which it affords protection.

12.12.3 Surge protection devices 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

(1) Clock displays surge protection devices at both ends

(2) Radio frequency feeder cables separately for each individual cable of VHF antenna & GPS antenna on both ends

(3) Armour of optical fibre cable shall be directly earthed at TER end and earthed through a surge protection device at the other end station;

12.12.4 Earthing requirements for each system, as a minimum, are summarized below:

Sub-system	Surge Protection for equipment in Outdoor			Surge Protection for equipment in room (indoor)		
	Equipment	Power Line	Data Line	Equipment	Power Cable	Data Line
OFC communication system	ODF	Earthing for optical fiber cable armour		SDH Node	yes	yes
				Data Network	yes	Yes
Telephone System	Outdoor telephone	Yes	Yes	LDF	N/A	yes
				MDF (incoming leased telephone line)	N/A	Yes
Clock	Slave Clocks out door	Yes	Yes	Sub-masterClock / Change over switch	No	Yes
SCADA	Depending upon the kind of interface					
Battery system				SMPS	Yes	N/A

12.13 Lighting Protection

12.13.1 While the station building will be provided with the lighting protection arrangements, the protection against lighting surges travelling through conductor into equipment shall be provided by contractor using appropriate device.

12.13.2 The contractor shall submit the proposed measures for review by the Engineer.

12.14 Housing, Enclosure and Cabinet

12.14.1 All equipment installed shall be able to withstand vibration level likely to be experienced in railway stations and along railway track site structure.

12.14.2 All design of housing enclosure shall be submitted to the Engineer for review.

12.14.3 Unless specified otherwise, all equipment to be housed in outdoor environment (open areas, etc.) shall be with IP 65 enclosure.

∗ End of Chapter 12 ∗

CHAPTER 13- VERIFICATION, TESTING AND COMMISSIONING

13.1 General Guidelines for Testing and Commissioning

13.1.1 The Contractor shall perform stage-wise testing and commissioning activities in accordance with the requirements given in this Specification.

13.1.2 The Contractor shall ensure that prior to the commencement of tests; documentation associated with tests has been reviewed without objection by the Engineer.

13.1.3 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 request. This is to indicate the readiness of the equipment/Subsystem/System for tests.

13.1.4 The Contractor shall provide all necessary test instruments, special tools, emulators, simulators and test software to carry out the tests.

13.1.5 The Contractor shall satisfy himself that all items interfacing to Project Contractors are in satisfactory condition for the Contractor's tests to be carried out. The Contractor shall provide simulation for testing in case the interfacing equipment is not available for testing.

13.1.6 The Contractor shall extend full support to the Engineer and provide all necessary facilities to enable convenient inspection of materials, work and testing.

13.1.7 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.

13.1.8 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.

13.1.9 The cost incurred by Engineer and/or Employer's Personnel against hotel and travel expenses for witnessing of testing shall not be borne by Contractor.

13.2 Testing Stages

13.2.1 The Contractor shall prepare and submit to the Engineer for review an On-site Testing and Commissioning Plan. On-site Testing and Commissioning shall include Installation Test, System Acceptance Test, Integrated Testing & Commissioning and Service Trial. The Contractor shall carry out testing and commissioning activities in the following phases:

(1) Factory Acceptance Tests;
(2) Installation Tests;
(3) System Acceptance Tests; and
(4) Integrated Testing and Commissioning.
(5) Service Trial.

13.3 Factory Acceptance Tests

13.3.1 The Contractor shall prepare and submit, at least six 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:

(1) a list of equipment and cables for individual Subsystems to have Factory Acceptance Test;
(2) the program of all the activities related to factory acceptance tests;
(3) the locations where factory acceptance tests to be carried out;
(4) the estimated duration of tests activities at each location; and
(5) Submission schedule of all the factory acceptance test procedures for equipment and cable.

13.3.2 Factory Acceptance Test shall be carried out for equipment and cables of all the Subsystems.

13.3.3 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.

13.3.4 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.

13.3.5 The Contractor shall prepare the factory acceptance test procedures for equipment and cables and submit 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).

The Factory Acceptance Test shall not be started unless the factory acceptance test procedures have been reviewed without objection by the Engineer.

13.3.6 Factory Acceptance Tests shall be witnessed by the Engineer, however on all major equipment items or Subsystems identified during Definitive Design Stage factory acceptance tests shall be witnessed jointly by the Employer's Personnel and the Engineer.

13.3.7 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.

13.3.8 The Factory Acceptance Tests are considered completed only if the Engineer without objection reviews the Factory Acceptance Test results.

13.3.9 FAT for equipment supplied as per RDSO Specification and from RDSO approved sources shall be carried out by RDSO.

13.4 Installation Tests

13.4.1 Installation Tests shall be carried out on individual Subsystem location by location after the completion of equipment physical installation.

13.4.2 The objective of the installation tests shall be to ensure the following:

(1) the equipment is installed in accordance with the reviewed design documentation
(2) the equipment is installed in accordance with the requirements detailed in this Specification
(3) all cables are properly and accurately connected and terminated
(4) all installation works are of acceptable workmanship

13.4.3 The Contractor shall develop procedures for Installation Tests and 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).

(1) The Installation Test shall not be started unless the installation test procedures have been reviewed without objection by the Engineer.

(2) All installed equipment and cables shall be physically inspected against all relevant reviewed design documentation.

(3) 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.

(4) The Contractor shall verify all the connections within the antenna network and measure the attenuation and VSWR values of all the connections.

(5) 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.

(6) The Installation Tests are considered completed only if the Engineer without objection reviews the Installation Test results.

13.5 System Acceptance Tests

13.5.1 The Contractor shall carry out System Acceptance Tests after the completion of the Installation Test.

13.5.2 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:

(1) after successful completion of the Installation Tests;

(2) after the Subsystems have been configured with correct settings and parameters;

(3) properly connected to the power supply and can be switched on for System Acceptance Tests; and

(4) Before the equipment of different locations are ready for Integrated Testing & Commissioning.

13.5.3 The Contractor shall develop System Acceptance Tests procedures for each Subsystem and System as a whole and submit to the Engineer for review.

13.5.4 The System Acceptance Tests procedures shall include:

(1) objectives of the System Acceptance Tests for all subsystems;

(2) objectives of the System Acceptance Tests for system as a whole;

(3) list of specifications and standards, reviewed design documentation for reference;

(4) step-by-step test instructions;

(5) list of test instrument and special tools;

(6) test record forms; and

(7) Pass or fail criteria.

13.5.5 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.

13.5.6 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.

13.5.7 The functional, electrical and timing performances of the Subsystems as well as System as a whole shall be verified against the requirements and relevant international standards.

13.5.8 The Contractor shall conduct end-to-end circuit test to verify the circuit integrity and electrical performance for all circuits including spare.

13.5.9 All local alarms, control and monitoring functions shall be verified.

13.5.10 All equipment settings and parameters shall be verified and recorded in the reviewed test record forms.

13.5.11 Coverage test shall be carried out on location basis for the Radio system.

13.5.12 All protection mechanisms such as hot-standby, parallel redundancy, automatic switchover, etc., built into the system and individual Subsystems shall be verified.

13.5.13 The system response time of relevant Subsystems and the System shall be tested and measured.

13.5.14 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.

13.5.15 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 without objection by the Engineer.

13.5.16 The System Acceptance Tests are considered completed only if the Engineer without objection reviews the System Acceptance Test results.

13.5.17 Upon completion of the System Acceptance Test, the individual Subsystem shall be operational and ready to be connected to other Subsystems and interfacing systems for testing.

13.6 Integrated Testing and Commissioning

13.6.1 The Contractor shall carry out Integrated Testing and Commissioning after the completion of the System Acceptance Tests.

13.6.2 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.

13.6.3 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.

13.6.4 Within one week upon completion of all interface test activities, the Contractor shall submit the test results to the Engineer for review.

13.6.5 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.

13.6.6 The Contractor shall advise the Engineer in writing the commencement date of the Reliability Demonstration Test.

13.6.7 The Contractor shall submit a Reliability Demonstration Test Plan to the Engineer for review at least three months before the test.

13.6.8 The Contractor shall include the following in the Reliability Demonstration Test Plan as a minimum:

(1) 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

(2) definition of relevant failures

(3) pass and fail criteria

(4) sample of fault logs

13.6.9 During the reliability demonstration test period, the Contractor shall record details of all faults in a fault log which shall include:

(1) the date and time the fault occurs

(2) the date and time the Contractor's staff arrive on site

(3) the date and time the fault is cleared and the normal operation is restored

(4) the description of the fault

(5) the cause of the fault

(6) equipment or component replaced

13.6.10 All fault logs shall be submitted to the Engineer for review.

13.6.11 The reliability demonstration test is considered a failure if:

(1) 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

(2) any fault resulting from the Design omission or commission of error requires Design modification in order to fix the fault

13.6.12 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.

13.6.13 The reliability demonstration test shall be repeated on the affected Subsystem or Subsystems for another three months until the test is successfully completed.

13.6.14 Within two weeks upon completion of the reliability demonstration test, the Contractor shall submit the test results for the Engineer to review.

13.6.15 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 without objection.

13.7 Service Trials

13.7.1 The Contractor shall provide all necessary support and attendance to the Engineer during the Service Trials period.

13.7.2 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.

13.7.3 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.

13.7.4 The Contractor shall submit a Manpower Plan to the Engineer for review at least 1 month before the commencement of the Service Trials.

13.7.5 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 13 ∗

CHAPTER 14 - SPARES, SPECIAL TOOLS AND TEST EQUIPMENT

14.1 Spares

14.2 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.

14.1.1 Contractor's Own Spares

14.1.1.1 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:

(1) the expected failure rate of the parts;

(2) population of the parts in the System;

(3) criticality of the parts in the System;

(4) availability and MTTR figures of the System;

(5) spare delivery lead time; and

(6) Workshop repair turnaround time.

14.1.1.2 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.

14.1.1.3 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.

14.1.1.4 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.

14.1.2 Contract Spares for Employer's Operational and Maintenance Requirements

14.1.2.1 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.

SN	Item	Total Quantity
1	SDH Node complete with all tributary cards and full hardware redundancy	1 of each type
2	2 Mb Mux complete with all channel cards and full hardware redundancy	2 of each type
3	All type of PCB cards including mother board ,Optical line termination Card,E1 Tributary card and power supply card for STM- Mux	10% of the total population for each type

SN	Item	Total Quantity
4	All type of PCB cards including mother board, 2MB card ,VF card, E&M Card ,Data card and power supply card for 2 MB Mux	10% of the total population for each type
5	Notebook computer loaded with OFC NMS software	2
6	Layer-3 Switch	10% of the total population for each type
7	Layer-2 Switch	10% of the total population for each type
8	Direct Line Console Complete for OCC	1
9	Direct Line Console Complete for SCR	1
10	PBX Subscriber Line Cards	10% of the total population for each type
11	PBX Junction Line Cards	10% of the total population for each type
12	PBX Switch Cards	10% of the total population for each type
13	PBX System Control Cards and Power Supply Card	10% of the total population for each type
14	Digital Telephone Instruments	10% of the total population for each type
15	Analogue Telephone Instruments	10% of the total population for each type
16	Media Gateway	10% of the total population for each type
17	Direct Line Telephone Instruments other than Direct Line Console	10% of the total population for each type
18	All type of replaceable/plug-in modules for Voice Recording System	10% of the total population for each type
19	Control Office Equipment of Control Communication Equipment	1 of each type.
20	Way-Station Equipment of Control Communication Equipment	10% of the total population for each type
21	Notebook Computer loaded with PBX NMS Software	1
22	Base Transceiver Station(BTS)	1
23	All type of Replaceable/Plug-In Modules for BTS	10% of the total population for each type
24	All type of Replaceable/Plug-In Cards/Modules for BSC and TRAU	10% of the total population for each type
25	All type of Replaceable/Plug-In Cards/Modules for OMC	1 Card of each type.

SN	Item	Total Quantity
26	Radio Dispatcher Console with associated hardware/accessories	1
27	Antennae for BTS	6
28	Cab Radio with Associated Hardware/Accessories	5
29	Replaceable/Plug-In Cards for Master Clock	1 Card of each type
30	Station Sub-Master Clock Complete	10% of the total population for each type
31	Digital Clock Units	10% of the total population for each type
32	Analogue Clocks	10% of the total population for each type
33	25 Watt VHF Transceivers along with Antennae, Associated Voice Recording Equipment and other associated Hardware/Accessories.	2
34	SMPS Based Float Cum Boost Charger (48 V DC)	10% of the total population for each type
35	All type of Replaceable/Plug-In Cards/Modules for SMPS Based Float Cum Boost Charger	10% of the total population for each type
36	Maintenance Free Batteries	10% of the total population for each type
37	Fuses of all types	10% of the total population for each type
38	Terminals of all types	10% of the total population for each type
39	Transient/Surge Protection Device	10% of the total population for each type
40	Optical Distribution Frame	10% of the total population for each type
41	Telephone Cable Termination frame	10% of the total population for each type
42	Copper Cable Jointing Kits for all sizes of cables	10% of the total population for each type
43	Splicing Kits for OFC	10% of the total population for each type
44	Optical Fibre Cable	10 km for each type
45	Optical Fibre Splice Box & remake loops	10% of the total population for each type.
46	Optical Pigtail Cables	10% of the total population for each type.
47	Outdoor Telephone Cable	10% of the total population (km) for each type.
48	Indoor Telephone Cable	10% of the total population (km) for each type.

SN	Item	Total Quantity
49	6 QUAD CABLE	10% of the total population (km) for each type.
50	All type of Connectors/Dummy Loads	10% of the total population for each type.
51	Emergency Socket	10% of the total population for each type.
52	Portable Emergency Telephone Set	50 Nos.

NOTE: The Quantity shall be rounded to nearest decimal natural number with minimum 1(one).

14.1.2.2 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.

14.1.2.3 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.

14.1.2.4 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.

14.1.2.5 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'.

14.1.2.6 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.

14.3 Special Tools and Test Equipment

14.2.1 The Contractor shall provide his own test equipment and tools during the Installation & Commissioning Periods and Defects Notification Period.

14.2.2 The following Special Tools & Test Equipment shall be suitably packed and supplied to the Employer.

SN	Item	Total Quantity	SN
1	E1 Analyser	Nos.	4
2	Auto fusion splicing machine complete.	Nos.	4
3	SDH Analyser	Nos.	2
4	OTDR mini	Nos.	4
5	OTDR main frames	Nos.	2
6	Optical fibre tool box Impairment (TIMS)	Nos.	4
7	Transmission measuring set	Nos.	2
8	Digital multi-meter	Nos.	12
9	Earth tester	Nos.	2

SN	Item	Total Quantity	SN
10	Megger 500 Volts	Nos.	2
11	Mega OHM meter	Nos.	1
12	Optical Power Source	Nos.	4
13	Optical Power Meter	Nos.	4
14	Optical Variable Attenuator	Nos.	2
15	PCM channel analyzer with printer	Nos.	1
16	Cable tool kit	Nos.	6
17	Mechanical splies	Nos.	**2**
18	Base Station Analyser	Nos.	2
19	RF Analyser	Nos.	2
20	Cable Route Locator	Nos.	2
21	Portable Generator 1.5 KVA	Nos.	2
22	Emergency light	Nos.	4
23	Ethernet Analyser	Nos.	2
24	Tarpoline tents	No	1
25	Duplex VHFsets	No.	2
26	Walkie talkie sets	No.	4
27	Cable & Antenna Analyser	Nos.	4
28	RF Power Sensors	Nos.	4
29.	Vehicle Mountable Drive Test Equipment for GSM-R	-	1 (System)
30	General purpose telecom tool kit.	Nos.	12
31.	Power supply (Variable) 0 to 60 Volt DC	Nos.	6
32	Vacuum Cleaner	Nos.	4
33	Maintenance Vehicle (Semi Utility Vehicle Type)	Nos.	2
34	Drilling machine with hammer action capable of working on wood, metal, concrete complete with chuck drill bits	Nos.	6
31	VHF Power Meter with all accessories	Nos.	1
32	Fibre Microscope	Nos.	4

14.2.3 The Contractor shall submit the technical specifications, datasheets and operational manual of each type of Special Tool & Test Equipment at least six months before the start of Defects Notification Period to the Engineer for review.

14.2.4 All Special Tools & Test Equipment shall be supplied together with all cords and connectors, operation manuals, complete diagrams, schematics, assembly and connection drawings, maintenance instructions and calibration certificates.

14.2.5 None of the Special Tools & Test Equipment provided for the Employer shall be used on site prior to delivery to the Employer.

14.2.6 The supply of Special Tool & Test Equipment shall be completed by the start of Defect Notification Period.

14.2.7 All tools and test equipment required in the field for restoration of the network shall be suitably fixed 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 14 ∗

15 PACKAGING, SHIPPING, STORAGE AND DELIVERY

15.1 Packaging

15.1.1 Cable Drums

15.1.1.1 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.

15.1.1.2 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.

15.1.1.3 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.

15.1.1.4 Cables shall be supplied on drums in the longest possible lengths and within practical limits. The drum when mounted on the wagon provided by the Engineer shall not exceed the specified Gauge of the railway.

15.1.1.5 The maximum allowable diameter of cable drum shall be 2000mm. The use of cable drums with diameter in excess of 2000mm shall be subjected to the review of the Engineer.

15.1.1.6 All cable drums shall be designed to be securely mounted on the wagon with the mounting accessories provided by the Contractor for cable laying along trackside.

15.1.1.7 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.

15.1.1.8 Each drum shall bear a distinguishing number and label “EDFC Telecommunications System”, either printed or neatly chiseled on the outside of one flange.

15.1.1.9 Particulars of the cable, i.e. voltage, length, conductor size, number of cores, finish, section and length number, 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.

15.1.2 Packaging of electronic equipment & other RDSO approved S&T items and its storage should be as per RDSO Guidelines issued from time to time.

15.2 Storage

15.2.1 The Contractor shall provide his own storage and facilities at his premises for storage of all items to be provided for this Contract before delivery to the Site for

installation.

15.2.2 The Contractor shall maintain records of stored items for this Contract and make available for the Engineer for inspection upon request.

15.3 Delivery

15.3.1 The Contractor shall deliver all items supplied under this Contract to the Site as desired by the Engineer.

15.3.2 The Contractor shall include the delivery activities in his three-month rolling programme to draw the Engineer's attention.

15.3.3 The Contractor shall ensure the Site is ready and in good conditions for delivery.

15.3.4 The Contractor shall ensure good conditions and security of the delivered items on Site.

15.3.5 The Contractor shall remove temporary fittings, if necessary, for delivery of his items to site and shall restore the fittings to the original state and to the satisfaction of the Engineer.

15.3.6 No dangerous goods shall be delivered to the Site.

End of Chapter 15

16. DOCUMENTATION

16.1 General

16.1.1 The Contractor shall submit a Submission Programme. The Submission Programme shall identify all submissions to be furnished, submission titles, submission numbers and target submission dates.

16.1.2 The Contractor shall provide configuration management to ensure that the System is correctly configured. The Contractor shall ensure that a configuration control programme is maintained. The programme shall ensure that the configuration of each item is recorded and maintained during the life of the Contract and Defects Liability Period.

16.1.3 The Contractor shall submit a Project Management Plan to the Engineer for review. The Project Management Plan shall identify the persons to be responsible and the methods and arrangement to carry out the Project Management.

16.2 Submission Requirement

16.2.1 General

16.2.1.1 The Contractor shall include records of amendment in each submission with the following details:

(1) Revision history and status of the submissions;
(2) Description on changes for each revision; and
(3) Contractor's signature for authorization of the submission indicating proper design check has been carried out before submitting to the Engineer.

16.2.1.2 The revision status and date of preparation of the submission shall be clearly indicated at the header of each page of the submission.

16.2.1.3 The first submission shall be revision 0 and subsequent revision shall be1, then 2, so and so forth.

16.2.1.4 The Contractor shall maintain records of the submission and updated record shall be included in the Monthly Progress Report. The submission record shall include the following details:

(1) Submission number;
(2) Submission title;
(3) Revision history;
(4) Status of Engineer's Response for each revision;
(5) Submission dates and dates of return from the Engineer for each revision; and
(6) Current status.

16.3 Levels of Submission

16.3.1.1 The Contractor shall adopt top-down approach and submit submissions of the following levels in a logical sequence for the review of the Engineer:

(1) System level related submission;
(2) Equipment level related submission;
(3) Installation Design related submission;
(4) Design calculations;

(5) Management plans and procedures;
(6) Approval certificates; and
(7) Miscellaneous submission.

16.3.1.2 System level related submission shall show the total system including the configuration block diagrams, operating principle, system features and functions, capacity, expandability, interconnection within the Subsystem, between Subsystems and between other Project Contractors.

16.3.1.3 Equipment level related submissions shall show the specifications on electrical, mechanical and functionality of the equipment/materials employed for the System and the Subsystems.

16.3.1.4 Installation design related submissions shall include:

(1) Installation methods and procedures for different types of installation activities;
(2) Drawings showing the equipment locations and positions, Subsystems coverage;
(3) Schematic and wiring diagrams;
(4) Cable core plan and numbering scheme;
(5) Equipment mounting details;
(6) Configuration data, parameters and settings;
(7) Cable route drawings; and
(8) Layouts in equipment racks, in equipment rooms, trackside, and all other equipment locations.

16.3.1.5 Design calculations shall demonstrate the performance of the System and Subsystems. Detailed requirements on calculation submissions are given in respective sections of individual Subsystem.

16.3.1.6 The Contractor shall submit a copy of certificates from relevant parties and authorities as required including equipment calibration certificates from manufacturers and laboratories.

16.4 As built-documentation

16.4.1 The as-built documentation shall describe the System as installed and provide sufficient information for other users, maintainers and developers to execute their responsibilities. All documentation shall be submitted for review by the Engineer, and shall include but not be limited to:
(1) Operation and Maintenance Manuals;
(2) Configuration Data Tables; and
(3) As-built drawings.

16.4.2 The configuration data tables shall be prepared for each individual Subsystem and on an item-by-item basis as well as on location basis.

16.4.3 The as-built drawings shall show the as-built details of the Works and shall include:
(1) Bill of quantity of equipment on location basis;
(2) Location and connectivity of all equipment and cables;
(3) Schematic and wiring diagrams;
(4) Cable core plan and numbering scheme;
(5) Equipment mounting details;
(6) Cable route drawings; and
(7) Layouts in equipment racks, equipment rooms, trackside and all other equipment locations.

16.4.4 Besides what is mentioned in this PS, contractor documents shall consist of management plans as stated in PS Signal. As far as possible submission requirement for both signal and telecom shall be combined as per the provision of PS signal and PS telecom and submitted to the Engineer.

End of Chapter 16

17 OPERATION AND MAINTENANCE SUPPORT

17.1 General

17.1.3.1 The Contractor shall investigate all failures, major failures, repetitive failures, design defects and provide all necessary corrective actions throughout the Defect Liability Period.

17.1.3.1 The Contractor shall investigate interference problems either from or to the systems of other Project Contractors and organizations other than EDFC and provide all necessary corrective actions throughout the Contract period.

17.2 Operation and Maintenance Documentation

17.2.3.1 The Contractor shall prepare Operation and Maintenance documentation and the Employer's Operation and Maintenance Manual Specification.

17.2.3.1 The first submission shall be made to the Engineer for review at least nine months prior to the start of Defect Liability Period.

17.3 Maintenance Plan

17.3.3.1 The Contractor shall submit a Maintenance Plan to the Engineer for review before the commencement of installation activities. Maintenance Plan shall be in line with DFCC Maintenance Philosophy.

17.3.3.1 The Maintenance Plan shall describe the proposed maintenance policy for preventive and corrective maintenance of the System to be followed by Employer, including, but not be limited to the following:

(1) Maintenance philosophy and approach;
(2) All necessary tasks for first line, second line, third line and corrective maintenance; and
(3) Frequency of each maintenance task.

17.3.3.1 The Contractor shall include the following information on each maintenance task described in the Maintenance Plan:

(1) Equipment, subsystems covered in the task;
(2) Step by step procedure to carry out the task;
(3) Tools and test equipment list of each task;
(4) Diagrams and flowcharts for illustration, if applicable;
(5) Recovery procedures, if applicable;
(6) Precautions the maintenance personnel to follow; and
(7) Estimated duration and man power required.

17.3.3.1 In addition to the Maintenance Plan, the Contractor shall also submit a Yearly Routine Maintenance Schedule to the Engineer for review and shall indicate the schedule of maintenance tasks in a calendar year.

17.4 Software Support

17.4.3.1 General

17.4.1.1 The Contractor shall provide full support to the Employer and Engineer for all computer programs provided by the Contractor under the Contract.

17.4.1.2 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.

17.4.1.3 The Contractor shall provide all tools, equipment, manuals and training necessary for the Employer's staff to maintain and re-configure all the software provided under the Contract.

17.4.1.4 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:

(1) Ensure that all new versions are fully tested and validated on the simulation and development system prior to installation;
(2) Ensure that all new versions are fully tested and commissioned once installed on the Site; and
(3) Deliver to the Employer any new version, together with the updated Operation and Maintenance Manuals.
(4) All new version of software shall be accompanied by a release note containing the following details:

(a) Version number;

(b) Modifications made to the previous version; and

(c) Checksum.

17.4.1.5 The Engineer shall not be obliged to use any new version and 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 attention including updating the files to suit new version.

17.4.3.1 Software Security Obligations

17.4.2.1 Within fourteen (14) days of the installation of any software, 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, the end user, two backup copies of the software, which shall include, without limitation:

(1) All source and executable code including all data configuration tables;
(2) All licenses in favour of the Employer for their perpetual use by DFCCIL for the entire life of the systems;

(3) All design documentation relating to the software; and
(4) Any specified development tools required for maintenance of the software, including, but not limited to, editors, compilers and linkers.

17.4.3.1 Supports during Defects Liability Period

17.4.3.1 General

17.4.2.2 During the Defects Liability Period, maintenance will be conducted by the Employer.

17.4.2.3 The Contractor shall provide workshop repair services of all defective and faulty items of the System.

17.4.2.4 The Contractor shall provide support and call-out services to the Employer as required to restore the System to normal operation in case faults and defects are found.

17.4.2.5 The Contractor shall submit a Manpower Plan showing the Contractor's organization available during the Defects Liability Period.

17.4.2.6 The Contractor shall ensure all his staff available during DLP shall be competent and with sufficient training in the responsible subsystems. CVs of the proposed staff shall be submitted to the Engineer for review.

17.4.3.1 Workshop Repair

17.4.2.7 The Contractor shall collect and repair defective parts that are removed from the System during maintenance.

17.4.2.8 The Contractor shall perform all necessary adjustments or alignments as 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.

17.4.2.9 The Contractor shall use only components of equal or higher specification than the original components in his repair activities.

17.5.2.1 The performance of the defective parts after repair shall not be degraded or deteriorated due to repairing.

17.5.2.2 The maximum turnaround time for workshop repair shall be less than 28 calendar days. The turnaround time is started to count when the defective parts are removed from the System and ended when the parts are repaired and returned to stock or to the System. Any extension of workshop repair time shall be agreed with the Employer.

17.4.3.1 Support and Call-out Services

17.5.3.1 The support and call-out services shall be available 24 hours per day and 7 days per week.

17.5.3.2 The Contractor shall provide sufficient number of competent and experienced staff for the support and call-out services.

17.5.3.3 The Contractor shall provide a list of maintenance staff together with the contact mobile telephone numbers who can be contacted for support and call-out services.

17.5.3.4 Any changes in the call-out numbers and the maintenance staff shall be notified to the Engineer at least two weeks before such changes become effective.

17.5.3.5 The Contractor's staff shall be available on Site for maintenance support within two hour upon receiving the call-out request from the Employer and shall proceed to perform corrective actions to restore the System to full normal operation.

17.5.3.6 The Contractor shall take every precaution to protect existing equipment from damage, and make good any damage caused.

17.5.3.7 Shall any abnormal system behavior like intermittent faults, interference, frequent repeated faults etc or the performance be found to deviate from the specified tolerances, the Contractor shall conduct investigation and report the findings to the Engineer together with the recommendation and proceed after the recommendation has been reviewed without objection by the Engineer.

17.4.3.1 Monthly Maintenance Meeting

17.5.4.1 The Contractor shall attend the Monthly Meeting with the Engineer to discuss the defects arising during the Defects Liability Period. The dates and agenda of the meeting shall be agreed with the Engineer.

End of Chapter 17

18 TRAINING

18.1 General Requirements

18.1.1 The contractor shall provide comprehensive training to the employer's staff, including employer's trainers, in accordance with the requirements contained in this particular specification.

18.1.2 The contractor shall provide competent training instructors, training manuals, training simulators, all necessary aids and materials as required for all the training courses.

18.1.3 All the training courses shall be conducted during installation period and completed before the commencement of testing and commissioning. No training course shall be started before the completion of Design phase.

18.1.4 The training shall be carried out either at Site or in DFCCIL Corporate/Regional Office. The cost of travel and boarding/lodging of Employers Personnel shall be borne by DFCCIL.

18.1.5 The training instructors shall be qualified, competent, with sufficient years of practical experience in the relevant fields and possess good communication skills in English.

18.1.6 The training instructors shall be either the system designer or engineering staff of the Contractor, the contractor's subcontractors or the equipment manufacturers.

18.1.7 The training courses and/or sessions shall include system performance requirements and all major equipment and works engineered by the Contractor. The training shall be in English.

18.1.8 The Contractor shall provide full-time management, co-ordination and supervision of the entire training programme to ensure the continuity of classes and proper distribution of training materials and be responsible for interfacing with the instructors.

18.1.9 The Contractor shall be required to arrange training to the Employer's staff in respect of design, installation, testing and commissioning of the System and each subsystem.

18.2 Training Period

18.2.1 Training in India shall be 50 training instructors' man days. The Class size will be maximum of 30trainees.

18.3 Training Materials

18.3.1 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 production.

18.3.2 The format of the trainer's guides and training manual for trainees shall be submitted to the Engineer for review.

18.3.3 The Contractor shall, for each course, distribute two sets of trainer's guides, one set of training manual for each trainee, two sets of trainer's guides and three additional sets of training manual to the Engineer before the commencement of the training course.

18.3.4 All the training materials shall be accurate and match with the actual Design of the System.

18.4 Training Records

18.4.1 The Contractor shall devise a system, standards in assessing the level of knowledge, understanding of the course content and proficiency of the trainees. The system and standards shall be submitted to the Engineer for review four weeks before the commencement of the training course.

18.5 Training Plan

18.5.1 Within sixty days after the Commencement Date of the Works, the Contractor shall submit a Training Plan to the Engineer for review.

18.5.2 The Training Plan shall include, but not be limited to, the following:

(1) Program of the training courses and submission schedule of the training materials;
(2) Overview and description of objectives of each training course;
(3) Location where the training courses to be conducted;
(4) Set ups for practical exercises;
(5) Contractor's training organization chart, including the role and Responsibilities of individual keypersons;
(6) Qualifications and experience of the training instructors; and
(7) Details of training simulators to be provided or developed, if applicable.

18.6 Training Courses

18.6.1 The Contractor shall provide training courses for each of the Subsystems, including, but not be limited to:

(1) Optical Fibre Communication System;
(2) Data Networking System
(3) Telephone System and Direct Line & Emergency Communication System;
(4) and Master Clock System.

18.6.2 Different types of training courses of each Subsystem shall be provided for staff from different disciplines. Operations training courses shall be provided for the operations staff. System engineering and maintenance courses shall be provided for engineering and maintenance staff. The Employer's Training Instructors shall attend all types of training courses such that the Employer's Training Instructors shall be able to subsequently train the Employer's staff in all aspects of operation

and maintenance of the System.

18.6.3 The Contractor shall determine the number of classes for each type of training course to ensure the objectives of the course can be met. *

18.7 Operations & Troubleshooting Training Courses

18.7.1 The operations & troubleshooting training courses shall be developed to provide all necessary knowledge and skills for operations staff of the Employer 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:

(1) Overview of the Telecommunications System;
(2) Brief description of the operation principle of the Subsystem;
(3) Operational features and functions;
(4) Familiarization and use of all man-machine interfaces involved;
(5) Reading and interpretation of system status and alarm messages or indications;
(6) Normal operating procedures;
(7) Operating procedures under emergency situation;
(8) Procedures for recovery from minor or simple faults; and
(9) Use of Operation and Maintenance Manuals and documentation.

18.7.2 Particular exercises shall be included in the operations training course for each trainee to operate and manage the system under normal and emergency operating conditions and simple faults recovery.

18.8 System Engineering Courses

18.8.1 The system engineering courses shall be developed to provide all necessary knowledge and skills:

(1) To perform system engineering management including system parameter configuration, enhancement, expansion and provision of new circuits; and
(2) To perform full maintenance, including both preventive and corrective maintenance, on the System.

18.8.2 The Contractor shall determine the content of the courses and the courses shall include the following as minimum:

(3) Overview of the Telecommunications System;
(4) Background theory;
(5) System features and functions;
(6) System configuration and operation principles;
(7) Description of system components and equipment down to card or module level;
(8) Test and commissioning procedures;
(9) Use of test equipment and special tools;
(10) Reading and interpretation of alarm indications, messages and print-outs;
(11) Preventive maintenance procedures;
(12) Fault diagnosis, troubleshooting and corrective maintenance procedures;
(13) Equipment settings and parameters configuration;
(14) Use of equipment manuals, Operation and Maintenance manuals,

circuit diagrams and wiring schematics;
(15) Methods and procedures to provide new circuits, system expansion and enhancement;
(16) Data, software backup and loading; and
(17) Use of software such as peripheral control and configuration, utility, database structure, generation and modification.

18.8.3 Practical exercises shall be provided for each trainee to practice the following as minimum:

(18) Use of test equipment and special tools;
(19) Preventive maintenance;
(20) Fault diagnosis and troubleshooting with induced faults set by the Contractor to simulate real-life situation; and
(21) Faulty modules or cards replacement and restore the system to normal operation.

18.9 Course Evaluation

18.9.1 The Contractor shall develop questionnaires to trainees for each training course in determining the level of satisfaction with the course content. Appropriate scoring weighting shall be assigned to each question in the questionnaires such that the scores shall reflect the trainee's satisfaction to the training course. The questionnaires shall be submitted to the Engineer for review four weeks before the commencement of the training course.

18.9.2 Upon completion of each training course, the Contractor shall distribute the questionnaires to the trainees to filling.

18.9.3 The Contractor shall submit a training report to the Engineer for review within two weeks after completion of each course. The training report shall include a summary of the training course conducted, the results of trainees' assessment and the course evaluation questionnaires.

18.9.4 The contractor shall submit the course evaluation criteria to the Engineer for approval.

End of Chapter 18

APPENDIX – I

Fax : 91-0522-2458500
Telephone: 91-0522-2451200(PBX)
91-0522-2450115 (DID)

Government of India Ministry of Railways
Research Designs & Standards Organisation
LUCKNOW-226011

No. STT/WL/MTRC/503 Dated: 16.09.2005

To,

The CSTE & CSTE / Construction,

1. Eastern Railway, Fairly Place, Kolkata – 700001
2. Northern Railway, Baroda House, New Delhi – 110001
3. Northeast Frontier Railway, Maligaon, Gowahati – 781011
4. North Central Railway, Allahabad

Sub: Uniform Numbering Scheme for Mobile Train Radio Communication Network for Indian Railways.

Uniform Numbering Scheme for Mobile Train Radio Communication has been prepared by RDSO for implementation on Zonal Railways. It is proposed to have network name as IR-GSM-R (maximum 8 Character), which will be displayed on mobile instruments. Railway Access Code (RAC) of Indian Railway MTRC network will be 091.

Presentation on numbering scheme was made on 15.09.2005 in the Railway Board during review of progress of MTRC sanctioned works. A copy of Uniform Numbering Schema for Mobile Train Radio Communication is sent herewith for comments.

It is requested that the comments on the numbering scheme may be sent to RDSO/ Lucknow within SEVEN days for finalizing the Numbering Scheme. If no reply is received within SEVEN days, it will be presumed that there is no comment from Railway Uniform Numbering Scheme is required by Eastern Railway and N.F. Railway for planning and programming of SIM cards and other functional requirements.

(A.K. Mishra)
Director/Stds../Tele-II
For Director General/Telecom

DA: As above.

NUMBERING SCHEME FOR MOBILE TRAIN RADIO COMMUNICATION NETWORK OF INDIAN RAILWAYS

1. International Mobile Subscriber Identity (IMSI)

Railway	MCC	MNC	MSIN	
			HLR Identification Code	
Zone	405	48	8 digit as listed below	00000000-99999999

For Eastern Railway, IMSI numbers will be

Railway	MCC	MNC	MSIN	
			HLR Identification Code	
Eastern Railway	405	48	250	00000000-99999999

1. Numbers from 0000000 to 9999999 can be used depending on numbers of SIM cards. Eastern Railway will be using only 410 SIM cards. Initially; the numbers to be used will be from 0000000-0000410. The balance may be kept as reverse to cater for future procurement.

2. If each Railway (18 nos.) will be having separate MSC and HLR, then they will be having separate HLR identification code i.e. 250 for Eastern Railway, 100 for Central Railway and so on as per table given below. If any two or more zones use same HLR, then they will be having same HLR identification code.

Railway	HLR Identification Code
Central Railway	100
East Central Railway	150
East Coast Railway	200
Eastern Railway	250
North Central Railway	300
North Eastern Railway	350
North Western Railway	400
North East Frontier Railway	450
Northern Railway	500
South Central Railway	550
South East Central Railway	600
South Eastern Railway	650
South Western Railway	700
Southern Railway	750
West Central Railway	800
Western Railway	850

2. Mobile Subscriber ISDN Number (Call Type 8) for Eastern Railway:

Railway	CC	NDC		CT 8	Subscriber Number			
		AC	ZONE		HQ/Divn.	Deptt.		
Eastern Railway HQ	91	99	25	8	0	0	GM	0000-0199
							Vigilance	0200-0299
							CPRO	0300-0399
							Law	0400-0499
							Civil Defence	0500-0599
							Audit	0600-0699
							Reserved	0700-0999
							MSRN, HON, GCN	1000-1999
							Reserved	2000-9999
	91	99	25	8	0	1	Personnel and Commercial	0000-9999
							Officers (Personnel)	0000-0099
							Supervisors (Personnel)	0100-0299
							Reserved	0300-0999
							Officers (Commercial)	1000-1099
							Supervisors (Commercial)	1100-1299
							Reserved	1300-1999
							Reserved	2000-9999
	91	99	25	8	0	2	Security and Medical	0000-9999
							Officers (Security)	0000-0099
							Supervisors (Security)	0100-0299
							Reserved	0300-0999
							Officers (Medical)	1000-1099
							Supervisors (Medical)	1100-1299
							Reserved	1300-1999
							Reserved	2000-9999
	91	99	25	8	0	3	Electrical	0000-9999
							General	0000-0299
							Officer	0000-0049
							(Maint.+Con.)	
							Supervisor	0050-0199
							(Maint.+Con.)	
							Reserved	0200-0299

Eastern Railway HQ							TRD	0300-0599
							Officer (Maint.+Con.)	0300-0349
							Supervisor (Maint.+Con.)	0350-0449
							Tower Wagon	0450-0459
							Reserved	0460-0599
							TRS	0600-0999
							Officers	0600-0649
							Supervisors	0650-0749
							Driver	0750-0999
							Reserved	1000-9999
	91	99	25	8	0	4	Engineering	0000-9999
							Officer (Maint.+Con.)	0000-0099
							Supervisors (Maint.+Con.)	0100-0299
							Reserved	0300-9999
	91	99	25	8	0	5	Operating	0000-9999
							Officer	0000-0099
							Supervisor	0100-0299
							Guard	0300-0599
							Station Master	0600-0899
							Reserved	0900-9999
	91	99	25	8	0	6	Mechanical	0000-9999
							C & W	0000-0399
							Officer	0000-0049
							Supervisor	0050-0199
							Reserved	0200-0399
							Power	0400-0699
							Officer	0400-0449
							Supervisor	0450-0499
							Driver	0500-0689
							ART	0690-0699
							Diesel	0700-0999
							Officer	0700-0749
							Supervisor	0750-0799
							Reserved	0800-9999
	91	99	25	8	0	7	S &T	0000-9999
							Officer (Maint.+Con.)	0000-0049
							Supervisors (Maint.+Con.)	0050-0249
							Reserved	0250-9999
	91	99	25	8	0	8	Stores	0000-9999
							Officer (Maint.+Con.)	0000-0049
							Supervisors (Maint.+Con.)	0050-0299

Eastern Railway HQ							Reserved	0300-9999
	91	99	25	8	0	9	Accounts	0000-0999
							Officer	0000-0999
							(Maint.+Con.)	
							Supervisors	0100-0299
							(Maint.+Con.)	
							Reserved	0300-9999
Eastern Railway Howrah Division	91	99	25	8	1	Same as HQ	Same as HQ	Same as HQ
Eastern Railway Asansol Division	91	99	25	8	2	Same as HQ	Same as HQ	Same as HQ
Eastern Railway Sealdah Division	91	99	25	8	3	Same as HQ	Same as HQ	Same as HQ
Eastern Railway Malda division	91	99	25	8	4	Same as HQ	Same as HQ	Same as HQ

Numbering scheme for MSISDN number is for Eastern Railway for MSISIDN numbers of other railways, ZONE code will be different as mentioned below.

Railway	ZONE
Central Railway	10
East Central Railway	15
East Coast Railway	20
North Central Railway	30
North Eastern Railway	35
North Western Railway	40
North East Frontier Railway	45
Northern Railway	50
South Central Railway	55
South East Central Railway	60
South Eastern Railway	65
South Western Railway	70
Southern Railway	75
West Central Railway	80
Western Railway	85

Besides two digit Zone code, one digit has been allotted to distinguish zonal headquarter and divisions, i.e. 0 for headquarter, 1 for first division, 2 for second division and so on. Similarly one digit has been identified for various departments in Zonal headquarter and divisions, i.e. 0 for Administration, 1 for Personnel & Commercial Deptt, 2 for Security & Medical Deptt, and so on.

3. Short Codes and Call Type 1 (CT 1):

Location Dependent Addressing (LDA) and Integrated Acknowledgment Center (IAC)

Digits Family	Digits Range		Digits #	Remarks
	From	To		
1 LDA	1200	1200	4	Route to most appropriate Primary Controller
	1300	1300	4	Route to Secondary Controller
	1301	1301	4	Route to C & W Control
	1302	1302	4	Route to Engineering Control
	1303	1303	4	Route to Traction Power Control
	1304	1304	4	Route to S&T Control
	1305	1305	4	Route to Security Control
	1306	1306	4	Route to Commercial Control
	1400	1400	4	Route to Power Controller
1 IAC	1612	1612	4	High priority call confirmations including Railway Emergency Calls
Short Codes	299	299	3	Train Groups: Emergency Call
	569	569	3	Trackside Maintenance Groups: Emergency Call
	599	599	3	Shunting Groups: Emergency Call

NOTE: 1201 to 1599 can be used for other secondary controllers.

4. Train Function Number (9 Digits) (Call Type 2):

CT (1 Digit)	Day (1 Digit) (Schedule originating day of train)	Train Running Number (5 Digit) XXXXX	Function Code (2 Digit)	Remarks
2	1-Monday	First Four digits will be as per train number and last digit will for type of train i.e. schedule train, link train or summer special train	01	Leading Driver
	2- Tuesday		10	Chief Conductor
	3-Wednesday		20	Catering Staff Chief
	4-Thursday		30	Railway security services chief
	5-Friday		80	Guard
	6-Saturday			
	7-Sunday			

NOTE:
XXXX = Four Digit Train Number. The last digit Y will be some numeric depending on the type of train i.e.
Y = 0 for scheduled trains
Y = 1 for link trains
Y = 2 for summer special/ holiday special trains.

5. Engine Function Number (11 Digits) (Call Type 3):

CT (1 digit)	Zone (2 digit)	Engine Number (6 Digit)	Function Code (2 Digit)	Remarks
3	As per ZONE Code of MSISDN	Last five digits will be as per the number of engine and first digit will be zero.	01	Leading Driver
			80	Guard

NOTE:

Goods trains can be identified by Engine Function Number.

6. Voice Broadcast Service (VBS) & Voice Group Call Service (VGCS) Number Plan (10 digits):

Call Type (CT) 50 for Group Call and Call Type (CT) 51 for Broadcast Call.

Call Type (CT) (2 digit)	Service Area Indicator (SA) (5 digits)	Group ID (GID) (3 digit)	Remarks
50 or 51	LLL03 (First Service area) Note: LLL is Location Number of Service Area. Zone = 2 digit. Division = 1 digit same as MSISDN. For example, for ER/HWH LLL = 251, for ER/SDAH LLL=252	200	Train Group: Drivers
		201	Train Group: Conductors
		202	Train Group: Catering
		203	Train Group: Guards
		204	Train Group: Security
		205	Accident Relief Train Group
		206	Emergency Doctor Group
		207-298	Reserved
		299	Train Group: Emergency Call
		500	Default shunting group
		501-520	Reserved for other shunting groups
		530	Station Staff (SM) group
		531	Security staff group
		539	Station and security staff: emergency call
		560	Engg. trackside maintenance group
		561	S&T maintenance group
		562	Electrical Maintenance group
		563	Mechanical maintenance group
		569	Trackside Maintenance group: Emergency Call
		570	Controller group
		579	Controller Group: Emergency call
		599	Shunting group: Emergency call
50 or 51	LLL01 (Second Service area)	DO	DO
50 to 51	LLL02-LLL99 (reserved for other	DO	DO

	service areas in a Division of a Zone)		

50: Group call in the defined service area.
51: Broadcast call in the defined service area.

7. Maintenance and Shunting Team Numbers (Call Type 6):

CALL TYPE (CT)	LOCATION NUMBER (LLLLL) (5 Digit)	FUNCTION CODE, FC (TT, Y, XX) (4 Digit)	Remarks
6	LLLLL is location number where Called Party is registered.	TT=5 for Shunting Team	TT= Team Type (1 Digit)
		TT=6-9 used for Maintenance Teams	
		TT=6 (S&T Maintenance Team-Signal and Telecom)	
	Zone=2 digit, Division=1 digit same as MSISDN. For two LL as 00 Last Three LLL as Zone and Division	TT=7 (Electrical General, TRD, TRS)	
		TT=8 (Mechanical C&W, Diesel, Power)	
		TT=9 (Engineering P Way & Works)	
	For example		
	00250=ER/HQ	Y=0 (TT=5) for Shunting Leader	Y= Team Member Function (1 Digit)
	00251=ER/HWH	Y=1-3 for Shunting Team Member	
	00252=ER/SDAH	For TT=6-9, Y=0-9 is available for team leader and members	
	00253=ER/ASN		
	00254=ER/MLDT	XX=00-99 available as team number for TT=6-9	XX=Team Number (2 Digit)
		FC for Maintenance team Number	
		6 0 00 (1st S&T maintenance team leader)	
		6 1 00 (1st S&T maintenance team-1st member)	
		6 2 00 (1st S&T maintenance team-2nd member)	
		6 0 01 (2nd S&T maintenance team-leader)	
		6 1 01 (2nd S&T maintenance team –Leader)	
		6 2 01 (2nd S&T maintenance team-2nd member)	
		Same pattern will be applicable for other teams also.	

8. Functional Structured Number (FSN) for Train Controller (Call Type 7):

Digits Family	Digits Range		Digits #	Remarks
	From	To		
FSN	7 LLLLL 01	7 LLLLL 01	8	Controller 1
FSN	7 LLLLL 02	7 LLLLL 02	8	Controller 2
FSN	7 LLLLL 03	7 LLLLL 03	8	Controller 3
FSN	7 LLLLL 04	7 LLLLL 04	8	Controller 4
FSN	7 LLLLL 11	7 LLLLL 99	8	Controller 5

LLLLL (5 digits) reserved for Location Number as specified in Call Type 8. For example: Zone + Division Code of HWH is 251. Therefore LLLLL for HWH Division of Eastern Railway will be 00251. Thus Primary Controller Functional Structured Number will become 70025101 (8 Digits).

APPENDIX – II

Details of Network Sub-system (NSS) of

MTRC System of Indian Railways

MSC Make: Nokia Solutions and Networks (NSN)
Model: D900
Version: SR14/CS6.0
Capacity: 4K
Country of Manufacture: NSN Germany
Interfaces and ConnectivityDetails:

Integrated MSC/HLR Node interfaces	E1 ISUP	E1 PRI	SS7 Channelized	SS7 V.35
BSS (A Interface)	19		2	
PSTN	3		2	
IWF	2			
SCP			2	
Railways Fixed Network		3		
Call Recording System	4		2	
Total	28	3	8	2

डेडीकेटेड फ्रेट कोरीडोर

BID DOCUMENT FOR

BALANCE WORKS OF DESIGN, SUPPLY, CONSTRUCTION, TESTING AND COMMISSIONING OF SIGNALLING, TELECOMMUNICATION AND ASSOCIATED WORKS OF DOUBLE TRACK RAILWAY LINES UNDER CONSTRUCTION ON A DESIGN BUILD LUMP SUM BASIS FOR DEEN DAYAL UPADHYAY - NEW BHAUPUR SECTION OF EASTERN DEDICATED FREIGHTCORRIDOR

SIGNALLING AND TELECOMMUNICATION WORKS

CONTRACT PACKAGE: 203(R)

Issued on: 27.08.2020

IFB No.: HQ/S&T/EC/D-B/DDU-BPUN

Part-2, Section V(B), Volume 9

Particular Specifications

Building & Civil structure Works

Employer:

DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LIMITED

A GOVERNMENT OF INDIA ENTERPRISE

under

MINISTRY OF RAILWAYS

INDIA

PARTICULAR SPECIFICATIONS:
BUILDING & CIVIL STRUCTURE WORKS

CHAPTER 1: Objective and Scope of Works

1.1 Objective

1.1.1. The Objective is to Design and Construct the Service buildings for Signalling and Telecommunication works of EDFC phase 2 in the manner and time stipulated in the Contract and to achieve the standard, performance and functionality specified in the contract.

1.2 Scope of Works

1.2.1. Design and Construction of all Services Buildings (SERs, TERs and S&T Power Supply Equipment Rooms) for Signalling and Telecommunication works of EDFC Phase 2 at Auto Location Hut, GSMR locations, Interfacing IR stations as required and additional buildings, if any for Signalling and Telecommunication works over and above the SER,TER and S&T Power Supply Equipment rooms being built as part of Station Building under Contract Package CP-201 & 202. In block section also a number of ALH fully/partially constructed will be handed over by DFCCIL to the contractor. The details of the same are provided under Appendix-15, General Specifications, Part 2, section V(A) of the bid document. Any modification/alteration/addition, if required has to be done by contractor.

1.2.2. TER shall preferably be co-located with SER and common S&T Power Supply Equipment Rooms shall be constructed for housing Signalling Power Supply Equipment and Telecom Power Supply Equipment. If it is not possible to co-locateSER and TER, the size of independent Signalling Power Supply Equipment Room and Telecom Power Supply Equipment Room shall be determined by Contractor in consultation with Engineer during design stage to meet the requirements of General Specifications and Particular Specifications.

1.2.3. The work of Design and Construction of Station Buildings, Staff Quarters and other service buildings viz. Integrated Maintenance Depots (IMD), Integrated Maintenance Sub Depots (IMSD), Guest Houses, Club/Institute, Gate Lodges etc. in EDFC Phase-2 shall be executed by Other Contractor(s). However, the necessary co-ordination for such buildings shall be done by this Contractor.

1.2.4. The E&M Works in all Service Buildings and Staff Quarters in EDFC Phase-2 will be designed and constructed by Other Contractor(s).However; the necessary co-ordination for such buildings shall be done by this Contractor.

1.2.5. Obtaining all necessary approvals from the relevant authorities for design and construction of the Works.

1.2.6. Rectification of the defects in the Permanent Works in a manner and to the standard as stipulated in the Employers Requirement.

1.2.7. In full recognition of the purpose and full acceptance of the obligation, liabilities & risks that may be involved, the Contractor shall undertake the design and construction of the building and structures works including and without limitations the design, construction and removal of all the temporary works and handover the completed works to the employer in a condition in which the Employer shall immediately use the works for the intended purpose

and/or to make them available to the Other Contractor(s) who shall commence and carry out their works without delay or disruption.

1.3 Architecture

1.3.1. The architectural design shall include but not be limited to site plans, floor plans, elevations, sections including detailed design and drawings. Structure would have signature architecture in terms of elevations and other architecture elements including efficient use of green building concepts and implementing sustainable building materials.

1.4 General Design & Construction Criteria

1.4.1. The Signalling & Telecommunication equipment particularly the electronic based equipment are sensitive to dust and the temperature. As such SERs, TERs and S&T Power Supply Equipment Rooms are required to be designed so that there is proper ventilation and the temperature inside the rooms does not raise much above the ambient temperature. These rooms should also be dust resistant so that the performance of the equipment does not degrade during its rated life cycle.

1.4.2. Contractor to submit all building plans for prior agreement of Engineer.

1.4.3. Necessary provision for Air-Conditioning, as required, shall be provided in SERs and TERs.

1.4.4. Environmental friendly material and equipment shall be used to the greatest extent possible.

1.4.5. **Durability and Maintenance**

(1) The Permanent Works shall be designed and constructed such that, they shall endure in a serviceable condition throughout their designed lives as described in the Design Criteria and standards contained in the technical specifications to minimise the cost of operation and maintenance whilst not compromising safety or the performance characteristics of the railway.

(2) Exterior wall finishes shall withstand the natural weathering effects with minimal periodic maintenance.

(3) Electrical and mechanical equipment where supplied shall be of a quality and durability, to fully meet the performance and operational requirements described in the Design criteria

1.4.6. Operational Requirements

(1) The Permanent Works near running lines shall be designed to permit the railway to operate satisfactorily at a maximum design speed of 100Km/h for freight trains. The Contractor shall ensure that proposed size and location of permanent works other contractor's works do not violate Schedule of Dimensions (SOD) of EDFC/ Indian Railways.

(2) Although the exact size of the SERs, TERs and S&T Power Supply Equipment Rooms will be determined at the design stage, the minimum carpet area shall be as per drawing in Annexure-1.

(3) The plinth level of Signalling Equipment Rooms, Telecommunication Equipment Rooms and Signalling & Telecommunication Power Supply Equipment Rooms in ALH/RH/LC Gates shall be at least 300mm above the Rail Level for embankment height upto 2 mtrs and 600mm above HFL/900mm above ground level whichever is higher for embankment height of more than 2 mtrs. The ceiling height of these rooms shall be approximately 3600mm above floor level.

The plinth level of for other buildings shall be 600mm above HFL/900mm above ground level whichever is higher for embankment height of more than 2 mtrs. The ceiling height of these rooms shall be approximately 3600mm above floor level.

(4) All buildings shall be provided with concealed ducts/pipes for wiring of signal and telecom facilities. In addition, ducts shall be provided on the floor for entry/exit of S&T cables and also for power supply. These arrangements shall be made in consultation with other contractors.

(5) The distance of chain link fencing from the walls of SER, TER and S&T power supply equipment room shall generally be 1.5 mters or as decided and approved by the Engineers during design stage.

(6) The locations of Permanent Structures shall be decided taking due note of the possible operational requirements in coming years.

(7) The foundations of buildings shall be designed for at least one story more than the requirement.

(8) The site of the work shall be cleared off the shrubs, rank vegetation, grass, bushes and other materials upto adequate depth as required as per site condition and rubbish removed outside the periphery of the area being cleared. The enclosed area between Chain Link Fencing and the building shall then be filled with the earth up to Rail Level as well as compacted by a suitable method as decided by Engineer.

(9) Load due to earth quake (as applicable for the earth quake zone in which station building falls) shall be assessed as per provisions of relevant IS Code with latest amendments/revisions.

(10) In the design and construction of the Works, the Contractor shall, as a fundamental objective and as a priority, ensure that staff and the public will be provided with as safe environment as is reasonably practicable throughout the execution period of the contract.

1.4.7. The Specifications for SERs, TERs and S&T Power Supply Equipment Rooms are given in Table 1:

Table 1: Technical Specifications

Sr. No.	Description	Specifications	Skirting / Dado
1	Signalling & Telecommunication Equipment rooms	Ceramic tile flooring	Same with 100 mm high
2	Signalling & Telecommunication Power Supply Equipment Rooms	Acid Proof tiles for flooring	Same with 2 metre high
3	Doors	Door Frame - Steel section painted with Enamel paint	
		Shutter Door - Water proof flush Door Steel section painted with Enamel paint.	
	Ventilators	Ventilators as per drawing no. DFC/HQ/EN/EC/D-B/MGS – New Bhaupur/S&T/01/2014	
		Grill - steel painted with Enamel paint.	

Sr. No.	Description	Specifications	Skirting / Dado
4	Internal Finish	Cement Plaster on all walls finished with Colour Wash	
5	External Finish	Cement Plaster on all walls and finished with snowcem paint or equivalent	
6	False Ceilings	600 x 600mm calcium silicate panels for Signal and Telecom. Equipment Room	

1.4.8. Lists Of Drawings:

Annexures	Drawing Names	Drawing Numbers
Annexure-1	Signalling & Telecom Equipment Rooms.	Drawing No- DFC/HQ/EN/EC/D-B/MGS – New Bhaupur/S&T/01/2014 revision 1

1.5 Contractor's Responsibilities

(1) The Contractor shall be responsible for detailed design, layout, construction, manufacture, supply, installation, testing and commissioning of the buildings, structures and building services wherever applicable under this Contract.

(2) The Contractor shall undertake that the designers shall be available to attend discussions with the Engineer and Employer at all reasonable times during the Contract period. The Designer shall be the same entity as proposed by the Contractor at the time of pre-qualification, unless otherwise approved by the Employer.

(3) Detailed design and drawings of buildings & structures shall be submitted by Contractor for review of Engineer.

(4) The Contractor shall be fully responsible, for the suitability, adequacy, integrity, durability and practicality of the Contractor's proposal.

(5) Wherever there is any inadequacy, insufficiency, impracticality or unsuitability in or of the Employer's Requirements or any part thereof, the Contractor's proposal shall take into account, address such inadequacy, insufficiency, impracticality or unsuitability.

(6) The Contractor shall certify that:-

- The Works have been or shall be designed, manufactured, installed and otherwise constructed to the applicable standards available using proven upto-date good practice.
- The Works shall, when completed, comply with enactments and regulations relevant to the Works.
- The design of the Works have taken or shall have taken full account of the effects of the intended manufacturing and installation methods, Temporary works and Contractor's equipment.

(7) The Building Works shall comply with Indian standards and lR regulations and standards as set out in this document.

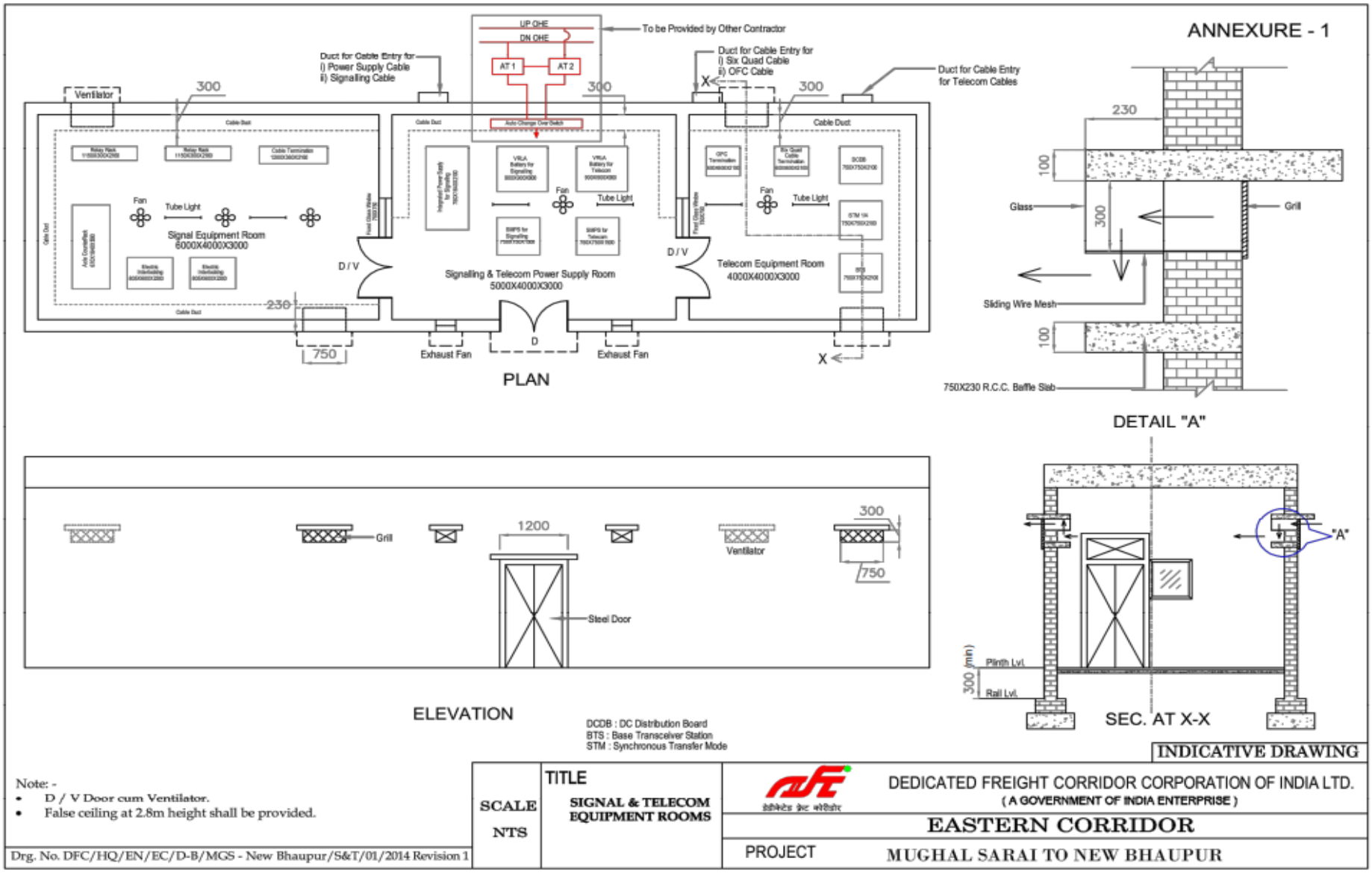
1.6 Aesthetics

1.6.1. The permanent works shall be designed to achieve an aesthetic character and provide a feeling of design commonality throughout the project.

1.7 Quality Control

1.7.1. Quality control aspects shall be kept in mind during the Design/construction and testing & commissioning phase, requirement for which has been specified at appropriate places in the bidding document.

End of chapter


ANNEXURE - 1
UP OHE
DN OHE
To be Provided by Other Contractor
AT 1
AT 2
Duct for Cable Entry for
i) Power Supply Cable
ii) Signalling Cable
Duct for Cable Entry for
i) Six Quad Cable
ii) OFC Cable
Duct for Cable Entry
for Telecom Cables
Ventilator
300
Fan
Tube Light
Signal Equipment Room
6000X4000X3000
D / V
Signalling & Telecom Power Supply Room
5000X4000X3000
Telecom Equipment Room
4000X4000X3000
230
750
Exhaust Fan
D
X
PLAN
230
100
300
Glass
Grill
Sliding Wire Mesh
750X230 R.C.C. Baffle Slab
DETAIL "A"
1200
Steel Door
ELEVATION
"A"
Plinth Lvl.
Rail Lvl.
SEC. AT X-X
DCDB : DC Distribution Board
BTS : Base Transceiver Station
STM : Synchronous Transfer Mode
INDICATIVE DRAWING
Note: -
D / V Door cum Ventilator.
False ceiling at 2.8m height shall be provided.
SCALE
NTS
TITLE
SIGNAL & TELECOM
EQUIPMENT ROOMS
DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
EASTERN CORRIDOR
PROJECT
MUGHAL SARAI TO NEW BHAUPUR
Drg. No. DFC/HQ/EN/EC/D-B/MGS - New Bhaupur/S&T/01/2014 Revision 1

डेडीकेटेड फ्रेट कोरीडोर

BID DOCUMENT FOR

BALANCE WORKS OF DESIGN, SUPPLY, CONSTRUCTION, TESTING AND COMMISSIONING OF SIGNALLING, TELECOMMUNICATION AND ASSOCIATED WORKS OF DOUBLE TRACK RAILWAY LINES UNDERCONSTRUCTION ON A DESIGN BUILD LUMP SUMBASIS FOR DEEN DAYAL UPADHYAY - NEW BHAUPUR SECTION OF EASTERN DEDICATED FREIGHTCORRIDOR

SIGNALLING AND TELECOMMUNICATION WORKS
CONTRACT PACKAGE: 203(R)

Issued on: 27.08.2020

IFB No.: HQ/S&T/EC/D-B/DDU – BPUN

(Part-3)

Employer:

DEDICATED FREIGHT CORRIDOR CORPORATION OF INDIA LIMITED

A GOVERNMENT OF INDIA ENTERPRISE

under

MINISTRY OF RAILWAYS

INDIA

PART 3 – Conditions of Contract and Contract Forms

Contents

Section- VI

General Conditions

(GC)

Section VI. General Conditions (GC) As per FIDIC Yellow Book 1999-Edition

GENERAL CONDITIONS OF CONTRACT (GC)
REFER TO

The conditions of Contract comprise the "General Conditions" which form part of the conditions of Contract for Plant and Design Build first edition 1999 published by the Federation Internationale Des Ingenieurs – Conseils (FIDIC) and the following "Particular Conditions" which include amendments and addition to such General Conditions.

Copies of the above FIDIC publication i.e. "Conditions of Contract for Plant and Design Build" can be obtained from

International Federation of Consulting Engineers
FIDIC Bookshop – Box- 311 – CH – 1215 Geneva 15 Switzerland
Fax: +41 22 799 49 054
Telephone: +41 22 799 49 01 E-
mail: fidic@fidic.org
www.fidic.org

Section -VII

Particular Conditions of Contract (PCC)

Section VII. Particular Conditions

The Conditions of Contract comprise the "**General Conditions**", which form part of the "Conditions of Contract for Plant and Design Build for Electrical and Mechanical, and for Building and Engineering Works designed by the Contractor", First Edition, 1999 published by the Fédération Internationale des Ingénieurs-Conseils (**FIDIC**), and the following "**Particular Conditions**", which include amendments and additions to such General Conditions. The General Conditions are incorporated herein by reference only and are not set out at length. The Contractor is deemed to have obtained for himself and read and fully understood the General Conditions in their entirety. The following Particular Conditions shall supplement the General Conditions in Section VI. Whenever there is a conflict, the provisions herein shall prevail over those in the General Conditions.

CLAUSE	PROVISIONS
Sub-Clause 1.1.3.10	**Insert additional Sub-Clause 1.1.3.10** *"Milestone" means the completion of a part of the Works, or the occurrence of an identified event.*
Sub-Clause 1.1.3.11	**Insert additional Sub-Clause 1.1.3.11** *"Stage" means the part of the Works identified as such and more particularly described in the Price Schedules, Part 5 Bidding Document*
Sub-Clause 1.1.3.12 Reference to Period	**Insert additional Sub-Clause 1.1.3.12:** **"***Reference to period" means period commencing 'from' a specified day or date and 'till' or 'until' a specified day or date shall include both such days and dates."*
Sub-Clause 1.1.6.9	**Delete the existing clause and modified as under:** "Variation" means any change to the scope of works, design criteria and specifications, and criteria for the installation, testing and commissioning, particular specifications of the completed works specified in the Employer's Requirements.
Sub-Clause 1.1.6.10 General Clauses	**Insert the following Sub-Clause 1.1.6.10:** "Any word or expression used in this Contract shall, unless otherwise defined or construed in this Contract, bears its

CLAUSE	PROVISIONS
Act 1897	ordinary English meaning and, for these purposes, the General Clauses Act 1897 shall not apply."
Sub-Clause 1.2. Interpretation	**Insert the following sub-paragraphs after sub-paragraph (d):** (e) the word "tender" is synonymous with "bid", and "tenderer" with "bidder" and the words "tender documents" with "bidding documents".
Sub-Clause 1.3 Communication	**Add the following paragraph at the end of this Sub-Clause:** "In this Contract, unless the context otherwise requires, any Contract, consent, approval, authorization, notice, communication, information or report required under or pursuant to this Contract from or by any Party or the Engineer shall be valid and effective only if it is in writing under the hand of a duly authorized representative of such Party or the Engineer, as the case may be, in this behalf and not otherwise"
Sub-Clause 1.5	**Delete sub paragraphs (a) to (h) and replace with the following:** 1) The Contract Agreement and the Appendices hereto; 2) Letter of Acceptance; 3) Addenda to Bidding Documents, if any; 4) Price Proposal Submission Sheet (BDF-20) & Price Schedule submitted by Contractor; 5) Appendix to Tender; 6) Particular Conditions; 7) General Conditions; 8) Employer's Requirements; 9) Contractor's Technical & Financial Proposal; 10) Information furnished in Part 4 (Reference Documents) of Bidding document; 11) Other completed bidding forms submitted with Bid; and 12) Any other documents forming part of the Employer's requirements and Bidding documents.

CLAUSE	PROVISIONS
Sub- clause 1.7 Assignment	**Delete Sub-clause 1.7 (a)**
Sub- clause 1.9 Errors in Employer's Requirements	**Delete Sub-clause 1.9 and replace with:** "If the Contractor suffers delay and/or incurs Cost as a result of an error in the Employer's Requirements with reference to purpose, scope, design and /or other technical criteria, installation, testing and commissioning, particular specifications for the works and an experienced contractor exercising due care would not have discovered the error when scrutinizing the Employer's Requirements with respect to purpose, scope, design and/or other technical criteria, testing and commissioning, Particular Specifications for the works under Sub-Clause 5.1 [General Design Obligations], 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 reasonable 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 (i) whether and (if so) to what extent the error could not reasonably have discovered, and (ii) the matters described in sub-paragraphs (a) and (b) above related to this extent.
Sub- clause 1.14 Joint and Several Liability	**Delete Sub- clause and replace with:** If the contractor constitutes (under applicable laws) a Joint Venture, etc, the following provisions will be applicable: (i) One of the members of the JV firm shall be its lead member who shall have majority (at least 51%) share of interest in the JV firm. The other members shall have a share of not less than 20% each in case of JV firms with upto 3 members and not less than 10% each in case of JV having more than three members. In case of JV with foreign member(s), the lead member has to be an Indian firm with a minimum share of 51%.

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	(ii) Joint And Several Liability - Members of the JV Firm to which the contract is awarded, shall be jointly and severally liable to the Employer (DFCCIL) for execution of the project in accordance with General and Particular Conditions of Contract. The JV members shall also be liable jointly and severally for the loss, damages caused to the DFCCIL during the course of execution of the contract or due to non-execution of the contract or part thereof. (iii) Duration of the Joint Venture Agreement - shall be valid during the entire currency of the contract including the period of extension, if any and the defect notification period after the work is completed. (iv) Governing Laws - The Joint Venture Agreement shall in all respect be governed by and interpreted in accordance with Indian Laws. (v) Once the Bid is submitted, the MOU shall not be modified/ altered / terminated during the validity of the Bid. In case the bidder fails to observe/comply with this stipulation, the full Bid Security Deposit (BDS) shall be liable to be forfeited. (vi) Approval for change of constitution of JV shall be at the sole discretion of the Employer (DFCCIL). The constitution of the JV shall not be allowed to be modified after submission of the Bid by the JV, except when modification becomes inevitable due to succession laws etc., provided further that there is no change in qualification of minimum eligibility criteria by JV after change of composition. However, the Lead Member shall continue to be the Lead Member of the JV. Failure to observe this requirement would render the offer invalid. (vii) Similarly, after, the contract is awarded, the constitution of JV shall not be allowed to be altered during the currency of contract except when modification become inevitable due to succession laws etc. and minimum eligibility criteria should not get vitiated. Failure to observe this stipulation shall be deemed to be breach of contract with all consequential penal action as per

CLAUSE	PROVISIONS
	contract conditions. (viii) On issue of LOA (Letter Of Acceptance), the MOU/JV agreement among the members of the JV to whom the work has been awarded, with the same shareholding pattern as was declared in the MOU/JV Agreement submitted alongwith the Bid, shall be got registered before the Registrar of the Companies under 'The Companies Act-2013' (in case of Company) or before the Registrar/Sub-Registrar under 'The Indian Partnership Act, 1932 (in case of Partnership Firm) or under 'The LLP Act 2008' (in case of LLP). A separate PAN shall be obtained for this entity. The documents pertaining to this entity including its PAN shall be furnished to the DFCCIL before signing the contract agreement for the work. In case the Bidder fails to observe/comply with this stipulation within 60 days of issue of LOA, contract is liable to be terminated. In case contract is terminated the DFCCIL shall be entitled to forefeit the full amount of BID SECURITY and other dues payable to the Contractor under this contract. (ix) No member of the Joint Venture shall have the right to assign or transfer the interest right or liability in the contract without the *written* consent of the other members and that of the employer (DFCCIL) in respect of the said Bid/*contract.*
New Sub-clause 1.15 **Fraud & Corruption**	If the Employer determines that the Contractor and/or any of its personnel, or its agents, or its Subcontractors, sub-consultants, services providers, suppliers and/or their employees has engaged in corrupt, fraudulent, collusive coercive, or obstructive 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 Clause15 shall apply as if such expulsion had been made under Sub-Clause 15.2. For the purposes of this Sub-Clause, *(i) "corrupt practice" is the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence improperly the actions of anotherparty[1];*

CLAUSE	PROVISIONS
	(ii) *"fraudulent practice" is any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation[2];* *(iii)* *"collusive practice" is an arrangement between two or more parties[3] designed to achieve an improper purpose, including to influence improperly the actions of another party;* *(iv)* "coercive practice" is impairing or harming, or threatening to impair or harm, directly or indirectly, any party[4] or the property of the party to influence improperly the actions of a party; *(v)* "obstructive practice" is (aa) deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede a investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation.

1. "Another party" refers to a public official acting in relation to the procurement process or contract execution]. In this context, "public official" includes employees of other organizations taking or reviewing procurement decisions.
2. "Party" refers to a public official; the terms "benefit" and "obligation" relate to the procurement process or contract execution; and the "act or omission" is intended to influence the procurement process or contract execution.
3. "Parties" refers to participants in the procurement process (including public officials) attempting to establish bid prices at artificial, non-competitive levels.
4. "Party" refers to a participant in the procurement process or contract execution.

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Sub- clause 2.1 Right of Access to Site	**Delete Sub- clause (b) in para 3.** Add the word "**Formation, Track**" after the word plant in 5th line of Para 1. **Delete the contents of Sub-Clause (b) in Para 3 and replace with:** "Payment of any such cost plus reasonable profit subject to a maximum of Rs.2000.00 (Two Thousand) per day for every km. For length less than a kilometer pro-rata amount shall be calculated provided further that if such delay in handing over does not affect the execution of S&T Works under this Contract, provisions under Para 2.1(b) of this sub clause shall not apply."
Sub-Clause 3.1 Engineer's Duties and Authorities	**Delete 4th paragraph** "However, whenever ……. given approval" of this Sub-Clause. **Add the following at the end of this Sub-Clause:** Notwithstanding anything contained hereinabove, the Engineer is required to obtain approval of the Employer before exercising specific authorities as listed below: i) Giving consent to proposed Subcontractors pursuant to Sub- Clause 4.4(b); ii) Giving consent to the Contractor's proposed Designer pursuant to sub-clause 5.1; iii) Clearance of concept design & drawings, and Yard Plans submitted by the Contractor for alignment and Works requiring sanction of Commissioner of Railway Safety; iv) Determination of any additional payment in accordance with Sub-Clause 3.5 read with Sub-Clause 2.5 & 20.1. v) Taking action in connection with variation in the Employers' requirement which has been initiated by the Employer. vi) Carrying out testing as per sub clause7.4.

CLAUSE	PROVISIONS
	vii) Carrying out Tests on completion as per clause9. viii) Employer's taking over of the works as per clause10. ix) Issue of performance certificate as per sub clause11.9 x) Approving any extension of time for completion of work. xi) Instructing or approving Variations pursuant to Sub-Clauses13.1, 13.2 and 13.3; except in an emergency affecting the safety of life or of the works or of adjoining property or track, he may, without relieving the Contractor of any of his duties and responsibility under the contract, instruct the Contractor to execute all such things as may, in the opinion of the Engineer, be necessary to abate or reduce the risk. In case the emergency mentioned above occurs on account of failure of Contractor, by way of not adhering to the sound industry practice or not taking adequate safety precautions, then no amounts shall be paid to the Contractor for attending to such emergencies
Sub-clause 4.2 Performance Security	**Add the following at the end of para 4.2(d)** – in which event the Employer shall forfeit the amount of the Performance Security as indicated in Sub-clause15.4. **Delete paragraph 5 of Sub-clause 4.2 "The Employer ... claim." and substitute by the following:** In case the Employer makes a claim on the Performance Security, which it was not entitled to make, the Employer shall forthwith refund such amount of claim to the contractor
Sub-clause 4.4 Sub-Contractors	**Delete first line and substitute by the following:** The contractor shall not sub contract more than 30% of the total works. This is in addition to the activities of sub-contracting to specialized sub- contractors highlighted in para 2.3.1(b) and 2.4 of Section III Qualification Criteria and requirements. **Add the following at the end of the sub clause:** "The Employer at his discretion may permit the replacement of specialized subcontractors named in the contract provided new specialist sub-contractors have required qualification"

CLAUSE	PROVISIONS
	The successful bidder shall not be allowed to sub-contract works to any contractor/supplier/vendor from a country which shares a land border with India unless such contractor is registered with the Competent Authority. The bidder may refer the guidelines in above connection issued by Government of India from time to time.
Sub-clause 4.7 Setting Out	**Delete paragraph 2,3 & 4 of Sub-clause 4.7 and substitute by the following:** Accuracy of these specified items of reference shall be deemed to have been verified by the Contractor. Accordingly, the Contractor shall have no right to claim towards time or cost caused due to errors in these specified items of reference.
Sub-Clause 4.10 Site Data	**Paragraph 1 of Sub-Clause 4.10.** Add at the end of the paragraph Accordingly, the Contractor shall have no claim in this regard." **Paragraph 2 of Sub-Clause 4.10.** **Delete** the words - To the extent which was practicable (taking account of cost and time). **Start** the word "the" with a capital letter. **Delete** "To the same extent" from the fourth line and **Start** the word "the" with a capital letter.
Sub-clause 4.12 Unforeseeable Physical Conditions	**Delete the Sub-Clause and Substitute by the following:** In this Sub-Clause, "physical conditions" means man-made or natural physical conditions including sub-surface and hydrological conditions which the Contractor encounters at site during the execution of the Works. Except as otherwise stated in the Contract: **(a)** the Contractor accepts total responsibility for having foreseen all difficulties and physical conditions; and **(b)** the Contract Price shall not be adjusted to take account of any unforeseen physical conditions
Sub-clause 4.25 Change of Control	**Insert the following additional Sub-clause** Any change in Control of the Contractor, or in case if the Contractor is a JV, any change of Control of any of the members of the JV, shall require prior approval of the Employer. Such approval shall not be unreasonably withheld,

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	unless, such change in Control, if had taken prior to the date of submission of the bid, would have rendered the Contractor or any such member in case the Contractor is a JV, ineligible to bid for the Project in terms of the Instructions to Bidders or in the opinion of the Employer such change in Control shall jeopardize national security or interest. For the purposes of this clause "Control" shall mean the possession, directly or indirectly, of the power to direct or cause the direction of the management and affairs of such person, whether through the legal and/or beneficial ownership of more than 50% (fifty percent) of the voting securities of such person, by agreement or otherwise or the power to elect majority of directors, partners or other individuals exercising similar authority with respect to such person.
Sub-clause 5.1 General Design Obligations	**Delete sub-clause 5.1 and substitute with the following:** The Contractor shall carry out, and be responsible for, the design of the Works. Design shall be prepared by qualified designers who are engineers or other professionals who comply with the criteria (if any) stated in the Employer's Requirements with reference to purpose, scope, design and/or other technical criteria for the works. Unless otherwise stated in the Contract, the Contractor shall submit to the Engineer for consent the name and particulars of each proposed designer and design Subcontractor. The Contractor warrants that he, his designers and design Subcontractors have the experience and capability necessary for the design. The Contractor undertakes that the designers shall be available to attend discussions with the Engineer at all reasonable times, until the expiry date of the relevant Defects Notification Period. Upon receiving notice under Sub-Clause 8.1 *[Commencement of Works],* the Contractor shall scrutinize the Employer's Requirements with reference to purpose, scope, design and /or other technical criteria, installation, testing and commissioning, particular specifications for the works. Within the period stated in the Appendix to Tender, calculated from the Commencement Date, the Contractor shall give notice to the Engineer of any error, fault or other defect found in the

CLAUSE	PROVISIONS
	Employer's Requirements with reference to purpose, scope, design and /or other technical criteria for the works. After receiving this notice, the Engineer shall determine whether Clause 13 *[Variations and Adjustments]* shall be applied, and shall give notice to the Contractor accordingly. If and to the extent that (taking account of cost and time) an experienced contractor exercising due care would have discovered the error, fault or other defect when examining the Site and the Employer's Requirements with reference to purpose, scope, design and/or other technical criteria, installation, testing and commissioning, particular specifications for the works before submitting the Tender, the Time for Completion shall not be extended and the Contract Price shall not be adjusted.
Sub-Clause 6.12 **Employment Foreign Nationals**	**Add New Sub-Clause:** The Contractor acknowledges, agrees and undertakes that employment of foreign personnel by the Contractor and/or its Subcontractors may be subject to grant of requisite regulatory permits and approvals including employment/residential visas and work permits, required if any, and the obligation to apply for and obtain the same shall always be of the Contractor. Notwithstanding anything to the contrary contained in the Contract, refusal of or inability to obtain any such permits and approvals by the Contractor or any of its Subcontractors shall not constitute Force Majeure event, and shall not in any manner excuse the Contractor from the performance and discharge of its obligations and liabilities under the Contract. The Employer, on a best effort basis, will provide reasonable assistance in obtaining such visas and permits, but without thereby incurring any liability whatsoever towards the Contractor.
Sub-Clause 7.4 **Testing**	**Insert the following at the end of this Sub-Clause:** The Contractor shall not be released from any liability or obligation under the Contract by reason of any such inspection or testing or witnessing of testing, or by the submission of reports of inspection or testing to the Engineer.

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Sub-Clause 8.2 Time for Completion	**Delete this Sub-Clause and substitute by the following:** Whole of the Works shall be completed within 730 days from the Commencement Date. **Milestone-1: 365 days from the Commencement Date** Prior to the occurrence of Milestone-1, the Contractor shall have completed; 1. In New Bhaupur-New Sujatpur Section a) All ALH, RH and GSM-R building works b) Laying, termination and testing of all outdoor cables c) Supply of S&T equipment and its progressive installation 2. Completion of 40% ALH, RH and GSM-R building works in Deen Dayal Upadhyay-New Sujatpur Section 3. Supply and installation of S&T equipment in OCC Entitling him a payment of at least 40% of Accepted Contract Amount. **Note**: 40% of the Accepted Contract Amount shall not include advance payment made to the contractor as per Clause 14.2 of GC. **Milestone-2: 455 Days from the Commencement Date** Prior to the occurrence of Milestone-2, the Contractor shall have completed; 1. Testing & commissioning of S&T works in New Bhaupur-New Sujatpur Section 2. All ALH, RH and GSM-R building works in Deen Dayal Upadhyay-New Sujatpur Section Entitling him a payment of at least 60% of Accepted Contract Amount. e: 60% of the Accepted Contract Amount shall not include advance payment made to the contractor as per Clause 14.2 of GC. **Milestone-3: 635 days from the Commencement Date** Prior to the occurrence of Milestone-3, the Contractor shall have completed;

CLAUSE	PROVISIONS
	1. Laying, termination and testing of all outdoor cables in Deen Dayal Upadhyay – New Sujatpur section. 2. Supply of S&T equipment and its progressive installation in Deen Dayal Upadhyay – New Sujatpur section. Entitling him a payment of at least 80% of Accepted Contract Amount. **Note**: 80% of the Accepted Contract Amount shall not include advance payment made to the contractor as per Clause 14.2 of GC. **Milestone 4: 730 days from the Commencement Date** Prior to the occurrence of Milestone-4, the Contractor shall have Completing all works as per the contract to enable certification including Integrated Testing & Commissioning and certification by an authority nominated by employer and taking over the entire works.
Sub-Clause 8.3	**Insert the following after 1st sentence in paragraph 1:** "Each programme shall take into account the progress of the Works under execution of Civil Works Contracts [Package 201 & 202] as well as that of Electrical Works Contract (Package 204) of the same section under the same Project [Eastern Dedicated Freight Corridor Project-2]." **Delete para 3 of Sub- Clause 8.3** "The Contractor shall …… *[Variation Procedure]."*
Sub-Clause 8.4	**Delete Sub-Clauses (c)** **Delete "(d)" and substitute as under:-** Unforeseeable shortages in the availability of Goods caused due to changes in laws in accordance with the provisions of Sub-Clause 13.7 **Add sub-clause (f)** -A cause of delay in handing over possession of Site in accordance with the provisions of Sub-clause 2.1
Sub-Clause 8.7 Delay Damages	**Delete Sub-Clause 8.7 and substitute by the following:** The Contractor shall complete the Works in accordance with the Time for completion of works set forth in Sub-Clause 8.2 [Time for Completion]. In the event that the Contractor fails to achieve any Milestone on the date set forth for such Milestone

CLAUSE	PROVISIONS
	in the Time for Completion, unless such failure has occurred due to Force Majeure or for reasons solely attributable to the Employer, the Contractor shall pay Delay Damages to the Employer in a sum calculated at the rate stated in the Appendix to Tender until such Milestone is achieved; provided that if the construction period for any or all Milestones is extended in accordance with the provisions of this Contract, the dates set forth in the Sub-Clause 8.2 [Time for Completion] shall be deemed to be modified accordingly and the provisions of this Sub-clause shall apply as if Appendix to Tender has been amended as above; provided further that in the event whole of the works are completed within the Time for Completion as stated in the sub-clause 8.2 (Time for completion), the Delay Damages paid under this Sub-Clause shall be refunded by the Employer to the Contractor, but without any interest thereon. It is agreed that recovery of Damages under this Sub-Clause shall be without prejudice to the rights of the Employer under this Contract including the right of Termination thereof. Provided further, in case the Contractor achieves the Milestone-4 (Completing all works as per the contract to enable certification including Integrated Testing & Commissioning and certification by an authority nominated by employer and taking over the entire works), within a period of less than 730 Days, as stipulated in PCC sub Clause 8.2, an incentive equivalent to INR 6,00,000/- (Rupees Six Lakh) per day, limited to maximum of 5% of the accepted contract amount would be payable to the Contractor in local currency. The Parties hereby accept that delays cause loss to the public and the national economy for whose benefit the Works is meant, and that the loss is not susceptible to precise measurement. The Parties hereby agree that the rate of Delay Damages agreed in this Clause 8.7 is a reasonable pre-determined amount, and that the Delay Damages are not by way of penalty. The Employer shall notify the Contractor of its decision to impose Delay Damages in pursuance with the provisions of this Sub-Clause. Provided that no deduction on account of Delay Damages shall be effected by the Employer without

CLAUSE	PROVISIONS
	notifying the Contractor its decision to impose the Damages. Further, the total amount of Delay Damages under Sub-Clause 8.7 shall not exceed the maximum amount of delay damages (if any) stated in the Appendix to Tender. These damages shall not relieve the contractor from his obligation to complete the work, or from any other duties, obligations or responsibilities which he may have under the contract.
Sub-Clause 8.8 **Suspension of Work**	**Delete Sub-Clause 8.8,** **Substitute deletion by the following:** In the event of the failure of the Contractor to duly and effectively perform any of its obligations or to perform proper execution of the Works in accordance with the provisions of this Contract, the Engineer may by notice require the Contractor to suspend forthwith the performance of any obligations under the Contract or the whole or any part of the Works. The Contractor shall, pursuant to the notice under this Sub-Clause, suspend the Works or any part thereof for such time and in such manner as may be specified by the Engineer and there upon carry out remedial measures to rectify the defects and secure the safety of the suspended works. The Contractor may by notice require the Engineer to inspect such remedial measures forthwith, with a request that the suspension hereunder may be revoked. The Engineer shall either revoke such suspension or instruct the Contractor to carry out such other and further remedial measures as may be necessary and the procedure set forth in this Sub-Clause shall be repeated until the suspension hereunder is revoked. All reasonable costs incurred for maintaining and protecting the Works and remedying the defects during the period of suspension shall be borne by the Contractor. During the period of Suspension, the Employer may at its own discretion, on behalf of the Contractor, undertake to fulfill any of the Contractor's obligations for remedying and rectifying the cause of Suspension. Provided that any cost incurred by the Employer in fulfilling the obligations of the Contractor for the remedying or rectifying the cause of Suspension shall be borne by the Contractor. The Employer shall have the right to deduct

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	any such expense incurred and another twenty percent thereof as Damages from any payment due or to be due to the Contractor under the provisions of this Contract. If and to the extent the cause for the suspension is the responsibility of the Contractor, the following Sub-Clauses 8.9, 8.10, and 8.11 shall not apply. The Contractor shall not be entitled to extra cost (if any), incurred by him, during the period of suspension of Work, if such suspension is: (a) provided for in the Contract; or (b) necessary for proper execution of Woks or by reasons of weather condition or by some default on the part of the Contractor; or (c) necessary for the safety of Works or any part thereof; or (d) necessary for the safety of adjoining public or other property or safety of the public or workmen or those who have to be at the site; or **(e)** to ensure safety and to avoid disruption of traffic and utilities, as also to permit fast repairs and restoration of any damaged utilities.
Sub-clause 10.2 Taking Over of Parts of the works	**Delete the Sub-Clause 10.2 in its entirety**
Sub-Clause 13.2 Value Engineering	**After the Sub-Clause add the following:** "The value engineering proposal shall not impair the essential character, functions or characteristics of the Work, including service life, economy of operation, ease of maintenance, desired appearance, or design, safety standards would not result in any reduction to the standard, or quality of works, or the performance of the Contractor and his obligations under the Contract. If the proposal of variation as a result of Value Engineering is approved, the reasonable share to be given to the Contractor shall be 30% of the net saving resulted due to Value Engineering."
Sub-Clause 13.3	**Add the following below the last paragraph:**

CLAUSE	PROVISIONS
Variation procedure	For varied works of items due to variation as per Sub-Clause 1.1.6.9 determination of adjustment to the Contract Price shall be based on the following: (a) Inputs of man-days, machine hours and quantities of materials; (b) (i) Prevailing market rates for Materials, hiring of equipment; (ii) Rates being paid by the Contractor for unskilled, semi-skilled and skilled worker as per the records maintained by the Contractor in accordance with the Laws; (c) Contractor's overheads and profit at the rate of 15 (fifteen) per cent of the cost arrived at on the basis of (a) and (b) above and; (d) Applicable taxes. No price adjustment shall apply. The approval for Variation shall state the period of extension of time, if any, allowed for the Variation. If no extension of time is allowed, the same shall be stated.
Sub-Clause 13.4 Payment in Applicable Currencies	**Delete Sub-Clause 13.4 and Substitute deletion by the following:** "The contract provides for payment of contract price in Indian Rupees only."
Sub-Clause 13.7 Adjustments for Changes in Legislation	**Delete first paragraph of the Sub-Clause and Substitute deletion by the following**: The Contract Price shall be adjusted to take account of any increase or decrease in Cost after the Base Date resulting from: a. a change in the Laws of the Country (including the introduction of new Laws and the repeal or modification of existing Laws);or b. in the judicial or official governmental interpretation of such Laws, or c. the commencement of any Indian law which has not entered into effect until the Base Date; or d. any change in the rates of any of the Taxes or royalties on Materials that have a direct effect on the Project which affect the Contractor in the performance of

CLAUSE	PROVISIONS
	obligations under the Contract. **Insert at the end of the Sub-Clause:** If as a result of change in law, interpretation, or rates of taxes or royalties, the Contractor benefits from any reduction in costs for the execution of this Contract, save and except as expressly provided for in this Sub- Clause or in accordance with the provisions of this Contract, the Contractor shall, within [28] days from the date he becomes reasonably aware of such reduction in cost, notify the Employer with a copy to the Engineer of such reduction in cost.
Sub-Clause 13.8 Adjustment for Changes in Cost	**Delete Paragraph 3 of this Sub-Clause and Substitute deletion by the following:** The adjustment to be applied to the amount otherwise payable to the Contractor, as valued in accordance with the amount certified in Payment Certificates for cost centers (sub clause 14.4), shall be determined from formulae. The formula for adjustment for changes in cost shall be as follows: (A) For Signalling Works Cost Centre **C-2, C-3, C-4, C-5 & C-6**, Telecommunication work Cost Centre **D-2, D-3, D-4, D-5, D-7 & D-8** and Building & Civil Structure works **Cost Centre E-1** The formula for adjustment for changes in cost shall be as follows: Pn = a + b(Ln/L0) + c(Mn/M0) + d(Fn/F0) where: "Pn" is the adjustment multiplier to be applied to the contract amount paid against cost center / stage as per Price Schedule for the completed stage of work; "a" is a fixed coefficient, stated in the table of adjustment data as given below, representing the non-adjustable portion of the work; "b" is a fixed coefficient, stated in the table of adjustment data as given below, representing the adjustable portion for labour component; "c" is a fixed coefficient, stated in the table of adjustment data

CLAUSE	PROVISIONS
	as given below, representing the adjustable portion for material component; "d" is a fixed coefficient, stated in the table of adjustment data given below, representing the adjustable portion for fuel & Power component; Values of a, b, c and d are as under for **C-2, C-3, C-4, C-5 & C-6 of Signalling**, Telecommunication work Cost Centre **D-2, D-3, D-4, D-5, D-7 & D-8** and Building & Civil Structure works price schedules**:** Fix Component(a) 0.15 Labour(b) 0.30 Material(c) 0.40 Fuel & Power(d) 0.15 Values for "Ln", "Mn" and "Fn" are the current cost indices or reference prices for period "n", each of which is applicable to the relevant cost element on the date 49 days prior to the last day of the period (to which the particular payment certificate relates). Values for "Lo", "Mo" and "Fo" are the base cost indices or reference prices, each of which is applicable to the relevant cost element on the base date. The values for current cost indices (Ln, Mn & Un) and base cost indices shall be taken as: "Ln" or "Lo": 'Consumer Price Index for Industrial Workers' published by the Labour Bureau, Govt. of India. "Mn" or "Mo": Wholesale Price Index for All Commodities (Code: 1000000000) published by Ministry of Commerce and Industry, Govt. of India. "Fn" or "Fo": Wholesale Price Index for Fuel & Power (Code: 1200000000) as published by Ministry of Commerce and Industry, Govt. of India.
Sub-Clause 14.1	**Add the following after the last paragraph –**

CLAUSE	PROVISIONS
Contract Price	The Contract Price includes all duties, taxes, royalties, premiums for various insurances, licenses and fees that may be levied in accordance with the laws and regulations in force as on the Base Date on the Contractor's Equipment, Plant, Materials and supplies acquired for the purpose of the Contract and on the services performed under the Contract. Nothing in the Contract shall relieve the Contractor from its responsibility to pay any tax including any tax that may be levied in India on profits made by it in respect of the Contract.
Sub-Clause 14.2 Advance Payment	**Delete Paragraph 1 and substitute by the following :** The Employer shall make an advance payment, as an interest bearing loan for mobilisation and design, when the contractor submits a guarantee in accordance with this Sub-clause. The total advance payment, the number and timing of installments (if more than one), the rate of interest, and the applicable currencies and proportions shall be as stated in the Appendix to Tender.
	Delete Paragraph 14.2(a) and substitute by the following: Deductions shall commence in the Payment Certificate in which the total of all certified interim payments (excluding the advance payment and deductions and repayments of retention) exceeds twenty five per cent (25%) of the Accepted Contract amount less provisional sums; and
Sub-Clause 14.3 Application for Interim Payment Certificates	**Delete first paragraph of this Sub-Clause and substitute by the following:** The Contractor shall prepare his monthly bill, in the format agreed with the Engineer, in six copies (hard) and a soft copy. This shall be accompanied by supplementary details in two hard copies and a soft copy. All hard copies shall bear the original signatures of the Contractor and submitted to the Engineer. If these are found in order then Engineer shall forward the same with copy of supplementary details to the Employer, with Interim Payment Certificate, as per clause 14.6, for payment by the Employer, otherwise return back all documents to the Contractor for rectification and resubmission. Responsibility of preferring the bill and entering the details shall vest with the Contractor. It is his responsibility to ensure that under no circumstances the payment claimed is more

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	than the amount equivalent of Work done for that stage. If it is discovered otherwise during the check by the Engineer or the Employer then a warning will be issued in the first instance and in the second instance amount equivalent to 10% of excess claimed shall be forfeited besides denying the extra claim. While submitting the bills all supplementary details like measurements, sketches, drawings, approvals, calculations etc. shall accompany the bill so that payment can be substantiated by the Engineer as well as the Employer. Even if no stage of work is completed during the month or Contractor does not choose to prefer a bill a 'NIL' bill shall be submitted by him. **Paragraph 2 (a) third line Delete the word "(g)" and substitute by "(h)"** **Add the following paragraph at the end** (h) any amount to be deducted for taxes in accordance with the applicable laws.
Sub-Clause 14.4 **Schedule of Payments**	**Delete this Sub-Clause and substitute with the following:** "The Employer shall make interim payments to the contractor as certified by the Engineer under Sub-Clause14.6 on the basis of the estimated value of the Works executed as determined in accordance with the following procedure: (a) The Price Schedules given in Part 5, Schedule C (C1 to C8) for Signalling Works , Schedule D (D1 to D9) for Telecommunication Works & Schedule E(E-1) for Civil Structure and Building Works lay down the frame work for estimating the value of stages of work completed. The Price Schedules specify the Contract Price for the Works offered by the Contractor and accepted by the Employer, along with the estimated value of work of different cost centres. The description of items of work in the Schedules does not limit in any way the Contractor's obligations under the Contract to provide all the Works described in the Employer's Requirements. (b) The entire Work has been divided into three (3) main Cost centres (C to E) along with their respective weightage percentages of the Contract Price in Annexure-I of Schedule A. Each of the cost centres has been broken into

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	items of works with percentage weightage of the Contract Price to items of the works/stages as indicated in Schedules C1 to C8, D1 to D9 & E1. (c) The Bidder shall compute, and supply to the Engineer, the total quantities (in units as described in the Price Schedules) of various items of works and components on the basis of detailed design reviewed/approved by the Engineer. (d) The Contractor shall base its claim for interim payment for each stage for various items of the work on completion till the end of the month for which the payment is claimed, supported with documents and an up-dated programme in accordance with the Employer's Requirements. (e) The weightage/percentage assigned to cost centres will apply only to the Contract Price stated in the Contract Agreement. It shall not apply to any additions or subtractions to the Contract Price arising from the issue of any Variation Orders. Each Variation Order shall specify the manner of interim payments and completion of stages for it. (f) For items of unchartered utilities, extra payment over and above the Contract Price shall be made in accordance with variation proposals made on case to case basis as per the provisions of Contract. Contractor shall make a detailed report/ proposal for removal/ relocation of unchartered utilities as per the procedure outlined in Part 2 "Employer's Requirement, Section V, General Specification."
Sub-Clause 14.6 Issue of Interim Payment Certificates	In the 1st Paragraph, 2nd line, '28' is replaced with '15'.
Sub Clause 14.7 Payment	In the Sub Clause 14.7 (b), 1st line, '56' is replaced with '30'.
Sub-Clause 14.9 Payment of Retention Money	**Delete the contents of first paragraph of this clause and replace with the followings:** A Retention amounting to 10 (ten) per cent of the value of the

CLAUSE	PROVISIONS
	work done shall be deducted by the Engineer in the first and following Interim Payment Certificates, until the amount so retained reaches a limit of Retention Money of 5(five) percent of the contract price. The contractor may replace the Retention Money deducted from Interim Payment Certificate on the quarterly basis with an unconditional bank guarantee from the Bank of Equivalent amount for the respective currency portions. The Bank Guarantees shall be valid up to the end of Defect notification period.
Sub-Clause 15.2 **Termination by Employer**	**Delete the words "the whole of" in Sub-Clause (d) and Substitute the deletion by the following words:** **"**more than the percentage specified in clause 4.4"
Sub-Clause 15.3 **Valuation at Date of Termination**	**Delete the last line of this Sub-clause "work executed .... Contract" and substitute by the following:** Work completed upto any defined stage of payment in accordance with the Contract. Extent of damages to the Employer due to termination under sub-clause 15.2 has been fixed as (1) Forfeiture of Performance Security (2) Forfeiture of Retention money/Security Deposit (3) five percent (5%) of the cost of the balance work at the date of termination. The Parties hereby agree that the rate of these damages agreed in this is a reasonable pre-determined amount, and that these damages are not by way of penalty.
Sub-Clause 15.4 **Payment after Termination**	**Delete the Sub-Clause 15.4 and substitute the following:** 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) withhold further payments to the Contractor until the actions in accordance with sub-paragraphs (c), and (d) are completed. (c) encash and forfeit the whole of the amounts of Performance Security and Retention Money and take possession of Plant and Materials delivered to Site, for which payment has been made by the Employer. (d) encash and appropriate the bank guarantee for the Advance Payment to recover the outstanding amount, if

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	any, of the Advance Payment **(e)** pay to the Contractor any sums due under Sub-clause 15.3 [Valuation at Termination], after the full amounts of the Performance Security and Retention Money/Security Deposit and five percent(5%) of the cost of the balance work (as per clause 15.3) and any other amount due from the Contractor have been received by the Employer. Any outstanding amounts against the Contractor shall immediately become due and payable by the Contractor to the Employer.
Sub-Clause 16.2 Termination by the Contractor	**Delete the sub-clause 16.2 (d)** **Delete the following words from 16.2 (e)** " of Sub-clause 1.7 [Assignment]"
Sub-Clause 17.3 Employer's Risks	**Sub-paragraph (h) - Delete**
Sub-clause 18.1 General Requirement of Insurance	**Sub –paragraph 6 (b) Modify as following** **"copies of the policies for the insurances described in Sub-clause 18.2 (Insurance for works and Contractor's Equipment), SubClause18.3 (Insurance against Injury to Person and Damage to Property) and Sub Clause 18.5 (Professional Indemnity Insurance)".**
Sub-Clause 18.2 Insurance of Works and Contractor's Equipment	**Sub-paragraph 4 (d) Delete** the words "(c), (g) and (h)", and substitute by the words "(c) and (g)".
Sub-Clause 18.3 Insurance Against Injury to Persons and Damage to Property	**Add the following at the end of this Sub-Clause:** The insurance policy shall include a cross liability clause such that the insurance shall apply to the Employer, the Contractor and Subcontractors (wherever applicable) as separately insured. The Employer shall not be liable for or in respect of any damages or compensation payable to any workman or other person in the employment of the Contractor or any Sub-Contractor (wherever applicable), other than death or injury resulting from any act or default of the Employer, his agents or employees. The Contractor shall indemnify and keep

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	indemnified the Employer against all such damages and compensation, other than those for which the Employer is liable as aforesaid, and against all claims, proceedings, damages, costs, charges, and expenses whatsoever in respect thereof or in relation thereto.
Sub-Clause 18.4 **Insurance for Contractor's Personnel**	**Add the following at the end of this Sub-Clause:** "The Employer shall not be liable for or in respect of any damages or compensation payable to any workman or other person in the employment of the Contractor or any Sub-Contractor (wherever applicable), other than death or injury resulting from any act or default of the Employer, his agents or employees. The Contractor shall indemnify and keep indemnified the Employer against all such damages and compensation, other than those for which the Employer is liable as aforesaid, and against all claims, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto."
Sub-Clause 18.5 **Professional Indemnity Insurance**	**Add new sub-clause** "The Contractor shall obtain the professional indemnity insurance, to cover the risk of professional negligence in the design of the Works carried by him, for the amount(s) stated in the Appendix to Tender and the insurance shall be maintained in full force and effect from the Commencement Date of the Works until 03 (three) years after the expiry of the Defects Notification /Extended Defects Notification Period. The insurance policy is required to indemnify the Employer as joint insured and the cover shall apply separately to each insured as though a separate policy had been issued for each of the joint insured. The Engineer will not certify any Payment Certificate until the Contractor has provided evidence of this insurance and its period of effectiveness."
Sub Clause 20.6 Arbitration	**Delete Sub-paragraph 1 (a, b & c) and replace as under –** Unless settled amicably, any dispute in respect of which the DAB's decision (if any) has not become final and binding shall be finally decided by reference to arbitration by a Board of Arbitrators appointed in accordance with sub-clause (i) below. Such arbitration shall be held in accordance with **The Arbitration and Conciliation (Amendment) Act, 2015**. The

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	seat of such arbitration shall be New Delhi, and the language of arbitration proceedings shall be English. i) The employer shall provide a panel of five (5) arbitrators to the contractor. The employer at the time of offering the panel of Arbitrator(s) to be appointed as Arbitrator shall also supply the information with regard to the qualification of the said Arbitrators nominated in the panel along with their professional experience, phone no. and address to the contractor. The contractor shall have to choose one Arbitrator from the panel of five. The employer shall also choose one Arbitrator from this panel of five. The third arbitrator shall be appointed by the two arbitrators from the panel of five so selected and shall act as presiding arbitrator. In case of failure of the two Arbitrators, appointed by the parties, to reach upon a consensus within a period of 28 days from their appointment as Arbitrators, the Presiding Arbitrator shall then be appointed by MD/DFCCIL. Arbitrator's Fee and other admissible expenses shall be as per extant DFCCIL instructions.

APPENDIX TO TENDER

Item	GC Sub-Clause	Data
Employer	1.1.2.2, 1.3(b)	Dedicated Freight Corridor Corporation of India Limited, 5th Floor Supreme Court, Metro Station Building Complex New Delhi, India – 110001 **Authorized Representative and its communication address:** *[To be inserted at the time of signing the Contract]*
Contractor	1.1.2.3 & 1.3(b)	*[To be inserted at the time of signing the Contract]*
Engineer	1.1.2.4, 1.3(b)& 3.1	*[To be inserted at the time of signing the Contract]*
Time for Completion	1.1.3.3	As per Sub-clause 8.2 of the Particular Conditions of Contract.
Section	1.1.5.6	The present contract consists of following two sections: i. New Bhaupur-New Sujatpur (Ch. 332.000 to Ch. 507.693) ii. New Sujatpur - Deen Dayal Upadhyay Ch. 119.500 to Ch. 332.000).
Defects Notification Period	1.1.3.7	Defect Notification Period for the Works shall be two year from the date of Taking Over of the Works (Sub-clause 10.1) and issue of Taking-Over Certificate by the Engineer.
Communications	1.3	In case of communication is through fax or emails, it should be confirmed through hard copy (paper) within 48 hours of transmission of fax or email. In case of delayed confirmation, the date and time of confirmation shall be deemed to be the date and time of hard copy (paper) communication delivered.
Law and Language	1.4	Indian laws & English Language
Right of Access to the Site	2.1	The Employer shall give Right to Access to site to the Contractor as per the following schedule subject to the Contractor providing Performance Security in terms of Sub- Clause 4.2 of General Conditions of

<table>
<tr><th>Item</th><th>GC Sub-Clause</th><th>Data</th></tr>
<tr><td></td><td></td><td>Contract.
<table>
<tr><th>SN</th><th>Period after Commencement Date in month</th><th>Cumulative percentage of formation to be handed over for work with respect to total length</th></tr>
<tr><td>1</td><td>01</td><td>60%</td></tr>
<tr><td>2</td><td>03</td><td>70%</td></tr>
<tr><td>3</td><td>09</td><td>80%</td></tr>
<tr><td>4</td><td>18</td><td>100%</td></tr>
</table>
The Employer shall give access to track for construction and/or for running of material trains, rail cum road vehicle etc in stages asunder:
<table>
<tr><th>SN</th><th>Period after Commencement Date in months</th><th>Cumulative percentage of track to be handed over for work with respect to total length</th></tr>
<tr><td>1</td><td>01</td><td>30%</td></tr>
<tr><td>2</td><td>10</td><td>50%</td></tr>
<tr><td>3</td><td>14</td><td>70%</td></tr>
<tr><td>4</td><td>20</td><td>100%</td></tr>
</table>
The above schedule is indicative.

The Employer shall give the contractor Right of access to and possession of the site progressively to enable the contractor to complete the work as per schedule. The Right and possession may not be exclusive to the contractor. The contractor shall draw/modify the schedule for completion of works according to progressive possession/Right of access of such sites.
Percentage of track to be handed over for the work may not be at a continuous stretch. The contractor should plan his work accordingly.</td></tr>
<tr><td>Amount of Performance Security</td><td>4.2</td><td>(Five) 05 Percent of the Accepted Contract Amount, in INR currency.</td></tr>
<tr><td>General Obligation Design</td><td>5.1</td><td>56 days.</td></tr>
</table>

Item	GC Sub-Clause	Data
Normal working hours	6.5	(Eight) 8 hours shift in a day and total (Forty eight) 48 hours in a week.
Amount Damages of Delay	8.7	**For Milestone 1** - Rs. 200,000/- (Rupees Two lakhs) per day of delay. **For Milestone 2** - Rs. 300,000/- (Rupees Three lakhs) per day of delay. **For Milestone 3** - Rs. 400,000/- (Rupees Four lakhs) per day of delay. **For Milestone 4** - Rs. 600,000/- (Rupees Six lakhs) per day of delay.
Limit of Delay Damages for the whole of the Works	8.7	(Five) 05 per cent of the Accepted Contract Amount in INR Indian currency.
Provisional Sum	13.5	No Provisional Sum is payable under this Contract.
Advance Payment	14.2	**Delete Paragraph 1 and substitute by the following: Mobilization Advance:** The Employer shall pay on written request by the Contractor a Mobilization Advance up to (Ten) **10** per cent of the Contract Price at an interest rate of 10% per annum. The Mobilization Advance shall be released in two installments asunder: (a) **Upto (Five) 5 percent:** On Submission of Performance Security and commencement of mobilization process; and (b) **Upto (Five) 5 percent:** On Submission of the preliminary designs and details of utilisation of initial Mobilization Advance of 5% to the satisfaction of Engineer. The Advance Payment will be released on submission of unconditional Bank Guarantee for an amount equivalent to 110% of the component of the advanc e payment requested by the Contractor. **Note:** The Contractor shall have a onetime option to reduce the Bank Guarantee for the mobilization advance by the amount already recovered, once the 50% of mobilization advance has been recovered.
Percentage of Retention	14.3 (c)	(Ten) 10 per cent

Item	GC Sub-Clause	Data
Limit of Retention Money	14.3 (c)	(Five) 5 per cent of the Contract Price
Plant and Materials for payment when delivered to Site	14.5 (c) (i)	For all the Goods / Material for which payment event/stage on Supply/Delivery has been specified in the Price Schedules
Payment	14.7	As per Sub-clause 13.4 of GC/PCC above
Delayed Payment	14.8	These financing charges shall be calculated at an annual rate of 8% (Eight percent) of Indian Currency.
Currencies of Payment[1]	14.15	Currency of payment will be INR
Evidence of Insurance	18.1 (a), 18.5	Before Commencement Date of Works
Relevant Policies	18.1(b)	Within 84 days of Commencement Date of Works
Insurance of Works and Contractors Equipment	18.2	Full Replacement Cost+15%; The Insurance Policy to cover the Employer's Risk as per Sub-Clause 17.3 of GC shall be taken by the Employer.
Minimum amount of deductibles for insurance of the Employer's Risk	18.2 (d)	Zero Deductible
Minimum amount of third party Insurance	18.3	Rs. 10 Cr. for any one occurrence.
Professional Indemnity Insurance	18.5	Rs. 25 Cr.
Appointment of Dispute Adjudication Board	20.2	The DAB shall comprise of one Sole member and sole member shall be appointed by Managing Director/DFCCIL.
Failure to Agree Dispute Adjudication Board	20.3 (d)	Managing Director/DFCCIL

[1] To be filled at the time of signing the contract.

Section VIII

CONTRACT FORMS

Section VIII

Contract Forms (CF)

Table of Forms

CF No	Sub-Clause	Description
01	1.1.1.3	Letter of Acceptance
02	1.6	Form of Contract Agreement
03	4.2	Form of Performance Security (Guarantee) By Bank
04	14.2	Mobilization Advance Payment Guarantee Form
05	14.3 c, 14.9	Form of Retention Money Guarantee
06	4.4	Memorandum of Understanding for a Subcontracting Agreement
07	4.4	Sub-Contractor's Warranty
08	5.1, 18.5	Form of Designer's Warranty
09	18	Insurance Requirement
10	14.3, 14.7	Standing Indemnity Bond For 'On Account' Payments

CF-1

LETTER OF ACCEPTANCE

(Sub-Clause 1.1.1.3)

To

Date:.....

Dear Sir

Project: BALANCE WORKS OF DESIGN, SUPPLY, CONSTRUCTION, TESTING AND COMMISSIONING OF SIGNALLING, TELECOMMUNICATION AND ASSOCIATED WORKSOF DOUBLE TRACK RAILWAY LINES UNDERCONSTRUCTION ON A DESIGN BUILD LUMP SUM BASIS FOR DEEN DAYAL UPADHYAY - NEW BHAUPUR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR

To,

This is to notify you that your bid proposal dated .. for execution of the above Project for the firm Contract Price of ..... (INR) and as corrected and modified in accordance with the bidding documents, is hereby accepted by DFCC.

You are requested to furnish the performance security as required by the contract and bidding document.

You are hereby instructed to proceed and prepare your mobilization for the execution of the said Contract works. Contract Agreement documents will be prepared and forwarded to you for signature.

Yours truly,

For – Dedicated Freight Corridor Corporation of India Limited

(_____)

Name:.....

Signature

Stamp

CF-2

CONTRACT AGREEMENT

(Sub-Clause 1.6 of General Conditions of Contract)

THIS AGREEMENT("Agreement")is made at New Delhi on the _____ day of _____,_____,
BETWEEN

(1) Dedicated Freight Corridor Corporation of India Limited, A Government of India enterprise under Ministry of Railways and a company incorporated under the provision of the Companies Act, 1946 having its registered office at 5thFloor, Supreme Court Metro Station Building Complex, New Delhi, India – 110001 (hereinafter referred to as **'the Employer'** which expression shall, unless repugnant to the context, deemed to include its successor and assigns), and **----------,** a company/corporation/JV incorporated under the laws of ----------having its principal place of business at----------(hereinafter referred to as "**the Contractor**" which expression shall, unless repugnant to the context, deemed to include its successor and assigns).

WHEREAS the Employer desires to engage the contractor to: BALANCE WORKS OF DESIGN, SUPPLY, CONSTRUCTION, TESTING AND COMMISSIONING OF SIGNALLING,TELECOMMUNICATION AND ASSOCIATED WORKSOF DOUBLE TRACK RAILWAY LINES UNDERCONSTRUCTION ON A DESIGN BUILD LUMP SUM BASIS FOR DEEN DAYAL UPADHYAY - NEW BHAUPUR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR**. (S&T Works),** and the Contractor has agreed to such engagement upon and subject to the terms and conditions hereinafter appearing.

NOW IT IS HEREBY AGREED as follows:

Article 1.	Contract Documents (Reference GC Clause 1.5)
Contract Documents	The following documents shall constitute the Contract between the Employer and the Contractor, and each shall be read and construed as an integral part of the Contract: This Contract Agreement and the Appendices hereto Letter of Acceptance Addenda to Bidding Documents, if any; Price Proposal Submission Sheet (BDF-20) & Price Schedule submitted by Contractor; Appendix to Tender; Particular Conditions; General Conditions Employer's Requirements Contractor's Technical & Financial Proposal; Information furnished in Part- 4 (Reference Document) of Bidding document Other completed bidding forms submitted with the Bid; and Any other documents forming part of Employer's requirements

	and Bidding documents Definitions (Reference GC Clause 1 and Employer's Requirement) Capitalized words and phrases used herein shall have the same meanings as are ascribed to them in the General Conditions & Employer's Requirements.
Article2. **Contract Price and Terms of Payment**	Contract Price (Reference GC Clause 14.1) The Employer hereby agrees to pay to the Contractor the Contract Price in consideration of the performance by the Contractor of its obligations pursuant to the Contract. The Contract Price shall be as specified in Schedule A Price Schedule or such other sums as may be determined in accordance with the terms and conditions of the contract. Terms of Payment (Reference GC Clause 14.4) The terms and procedures of payment according to which the Employer will reimburse the Contractor are given in Terms and Procedures of Payment subject to such additions thereto or deductions there from as may be made under the provisions of the contract at the times and in the manner prescribed by the Contract. The amount payable under Schedule –C1 to C8, D1 to D9 and E1 is adjusted in accordance with GC 13.8 or with any of the other terms of the Contract.
Article 3. **Commencement Date**	Commencement Date (Reference GC Clause 1.1.3.2) 42 days from the date of issue of letter of acceptance or as indicated in the letter of acceptance.
Article 4. **Time for Completion**	4.1 Completion (Reference Clause 1.1.3 GC & Employer's Requirements) In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the contractor hereby covenants with the Employer to execute and complete the Works by 730 days and remedy any defects therein in conformity in all respect with the provisions of the Contract.
Article 5. **Communications**	5.1 The address of the Employer for notice purposes, pursuant to GC 1.3 is: The Chief General Manager/Allahabad (W), Dedicated Freight Corridor Corporation, 2nd Floor, DFCCIL OCC Building, (Opposite to IOCL Complex), Subedarganj

Allahabad-211012

5.2 The address of the Contractor for notice purposes, pursuant to GC 1.3 is: _____ .

Article 6.

Obligations of the Contractor

6.1 Contractor's General Obligation GC 4.1

The Contractor shall ensure full compliance with the laws of India including taxation and other fiscal laws, with regard to the Contract and the Works shall be solely responsible for the same. The Contractor shall submit copies of acknowledgements evidencing filing of returns every year and shall keep the Employer fully indemnified against liability of levies, custom duties, tax, interest, penalty etc. of the Contractor in respect thereof, which may arise.

IN WITNESS WHEREOF the parties hereto have caused their respective Common Seals to be hereunto affixed/ (or have hereunto set their respective hands and seals) the day and year first above written.

For and on behalf of the Contractor	For and on behalf of the Employer
Signature of the authorized official Name of the official	Signature of the authorized official Name of the official
Stamp/seal of the Contractor	Stamp/Seal of the Employer

SIGNED, SEALED AND DELIVERED

By the said _____Name _____	By the said _____Name _____
on behalf of the Contractor in the presence of:	on behalf of the Employer in the presence of:
Witness_____	Witness_____
Name_____	Name_____
Address _____	Address _____

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FORM OF PERFORMANCE SECURITY (GUARANTEE) BY BANK

(Sub-Clause 4.2)

This deed of guarantee made this day of.....Between Bank of (hereinafter called the"**Bank**") of the one part, and Dedicated Freight Corridor Corporation of India Limited called the "**Employer**" of the other part.

Whereas Dedicated Freight Corridor Corporation of India Limited has awarded the contract for ..... (Hereinafter called the Contract) to.....(Hereinafter called the **Contractor**). (Name of the Contractor)

AND WHEREAS the Contractor is bound by the said Contract to submit to the Employer a Performance Security for a total amount of Rs..... (Amount in figures and words). Now we the undersigned .....(Name of the Bank) being fully authorized to sign and to incur obligations for and on behalf of and in the name of .....(full name of the Bank), hereby declare that the said bank will guarantee the Employer the full amount of Rs. .....(Amount in figures and words).

After the Contractor has signed the aforementioned Contract with the Employer, the Bank is engaged to pay the Employer, any amount up to and inclusive of the aforementioned full amount of the Performance Security upon written order from the Employer to indemnify the Employer for any liability of damage resulting from any defects or shortcomings of the Contractor or the debts he may have incurred to any parties involved in the Works under the Contract mentioned above, whether these defects or shortcomings or debts are actual or estimated or expected. The Bank will deliver the money required by the Employer immediately on demand without delay and demur and without reference to the Contractor and without the necessity of a previous notice or of judicial; or administrative procedures and without it being necessary to prove to the Bank the liability or damages resulting from any defects or shortcomings or debts of the Contractor. The Bank shall pay to the Employer any money so demanded notwithstanding any dispute/disputes raised by the contractor in any suit or proceedings pending before any court, Tribunal or Arbitrator/s relating thereto and the liability under this guarantee shall be absolute and unequivocal.

This guarantee is valid till.....(the initial period for which this Guarantee will be valid must be for **at least 6 months (six months) longer than the anticipated expiry date of Defects Notification Period as stated in Clause 1.1.3.7 of the Appendix to Tender**.

At any time during the period in which this guarantee is still valid, if the Employer agrees to grant a time extension to the Contractor or if the Contractor fails to complete the Works within the time of completion as stated in the Contract, or fails to discharge himself of the liability or damages or debts as stated in the Contract, it is understood that the Bank will extend this guarantee under the same conditions for the required time on demand by the Employer and at the cost of the Contractor.

The Guarantee hereinbefore contained shall not be affected by any change in the Constitution of the Bank or of the Contractor.

The neglect or forbearance of the Employer in enforcement of payment of any moneys, the payment whereof is intended to be hereby secured or the giving of time by the Employer for the payment hereof shall in no way relieve the Bank of their liability under this deed.

The expressions "**the Employer", "the Bank" and "the Contractor**" hereinbefore used shall include their respective successors and assigns.

Notwithstanding anything contained herein:

Our liability under this bank Guarantee shall not exceed Rs.....(Rupees----------).

This bank guarantee shall be valid up to .....

We are liable to pay the guarantee amount or part thereof under this bank Guarantee only and only if you serve upon us a written claim or demand on or before.....

In witness whereof I/We of the Bank have signed and sealed this guarantee on the.....day of ..... (Month) being herewith duly authorized.

For and on behalf of

The ..... bank

Signature of Authorized bank Official

Name .....

Designation .....

Stamp/seal of the Bank:.....

Signed, sealed and delivered

For and on behalf of the

Bank of the above

Name _____in

The presence of:

Witness1.	Witness 2.
Signature.....	Signature.....
Name.....	Name.....
Address.....	Address.....

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Mobilization Advance Payment Guarantee Form
(Sub-Clause 14.2)

Bank guarantee made on this …… Between …… (here in after called "**the Bank**") of the One Part and Dedicated Freight Corridor Corporation of India Limited. (here in after called "**the Employer**") of the other Part.

WHEREAS Dedicated Freight Corridor Corporation of India Limited has awarded the Contract no…… for "……" (here in after called "**the Contract**") to ……Having its registered office at (here in after called "**the Contractor**").

AND WHEREAS vide Clause14.2 of the General Conditions of Contract, Mobilization Advance upto ---% (--- percent) of the original contract value of Rs…… is payable to the contractor against Bank Guarantees, the Contractor hereby applies for Mobilization Advance of--%(percent) amounting to Rs……/- (Rupees……) of the Contract Price, as per Appendix to Tender

AND WHEREAS this Bank Guarantee is for Rs……/-(Rupees …….) being the 1st one of the two Bank Guarantees, totaling to the above Mobilization Advance amount of Rs ……./-.

Now, we the undersigned, Bank of……,being fully authorized to sign and to incur obligations for and on behalf of and in the name of Bank of ……hereby declare that the said Bank will guarantee the Employer the full amount of Rs ……/- (Rupees…..) as stated above.

We, Bank of…… , do hereby unconditionally, irrevocably and without demur guarantee and undertake to pay the Employer immediately on demand any or all money payable by the Contractor to the extent of Rs. ……/-(Rupees……) without any demur, reservation, context, recourse or protest and/or without any reference to the Contractor. Any such demand made by the Employer on the Bank shall be conclusive and binding notwithstanding any difference between the Employer and the Contractor on any dispute pending before any court, Tribunal, Arbitrator or any other authority. We agree that the guarantee herein contained shall be irrevocable and shall continue to be enforceable till the Employer discharges this guarantee.

This guarantee is valid till …….

At any time during the period in which this guarantee still valid of the Contractor fails to fulfill its obligation under the Contract, it is understood that the Bank will extend this guarantee under the same condition for the required time on demand by the Employer at the cost of the Contractor.

The Guarantee hereinbefore contained shall not be affected by any change in the constitution of the Bank or of the Contractor.

The neglect or forbearance of the Employer in enforcement of payment of any money, the payment whereof is intended to be hereby secured or the giving of time by the Employer for the payment hereof shall in no way relieve the Bank of their liability under

this deed.

The expressions "**the Employer**", "**the Bank**" and "**the Contractor**" hereinbefore used shall include their respective successors and assigns.

Notwithstanding anything contained herein:

Our liability under this Bank Guarantee shall not exceed Rs……/-(Rupees)

this bank Guarantee shall be valid up to…….

We are liable to pay the guaranteed amount or any part thereof under this Bank Guarantee only and only if you serve upon us a written claim or demand on or before ……(date of expiry of Guarantee).

In witness whereof we of the Bank have signed and sealed this Guarantee on the……day of……being herewith duly authorized.

For and on behalf of the Bank of…….

Signature of Authorized Bank Official

Name _____

Designation _____

Stamp/Seal of the bank_____

Signed, sealed and delivered for

and on Behalf of the bank by the

above named

…… in the presence of

Witness 1

Signature _____

Name_____

Address _____

Witness 2

Signature _____

Name_____

Address _____

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FORM OF RETENTION MONEY GUARANTEE
(Sub-Clause 14.3c, 14.9)

Brief description of Contract

Name and address of Beneficiary

_____(whom the Contract defines as the Employer).

We have been informed that_____(hereinafter called the "Principal") is your Contractor under such Contract and wishes to receive early payment of [part of] the retention money, for which the Contract requires him to obtain a guarantee.

At the request of the Principal, we(*name of bank)*_____hereby irrevocably undertake to pay you, the Beneficiary / Employer, any sum or sums not exceeding in total the amount of__(the "Guaranteed Amount", say:_____) upon receipt by us of your demand in writing and your written statement stating:

a) that the Principal has failed to carry out his obligation(s) to rectify certain defect(s) for which he is responsible under the Contract, and

b) the nature of such defect(s).

c) That the Principal has failed to carry out his obligation(s) for which he is responsible under the Contract,

At any time, our liability under this guarantee shall not exceed the total amount of retention money released to the Principal by you, as evidenced by your notices issued under Sub-Clause 2.5 and 14.9 of the Conditions of the Contract with a copy being passed to us.

Any demand for payment must contain your signature(s) which must be authenticated by your Bankers. The authenticated demand and statement must be received by us at this office on or before (*the date 56 days after the expected expiry of the Defects Notification Period for the Works)* _____(the "**Expiry Date**"), when this guarantee shall expire and shall be returned to us.

We have been informed that the Beneficiary may require the Principal to extend this guarantee if the performance certificate under the Contract has not been issued by the date 28 days prior to such Expiry Date. We undertake to pay you such Guaranteed Amount upon receipt by us, within such period 28 days, of your demand in writing and your written statement that the performance certificate has not been issued, for reasons attributable to the Principal, and that this guarantee has not been extended.

This guarantee shall be governed by the laws of Republic of India.

Date Signature(s)

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MEMORANDUM OF UNDERSTANDING FOR A SUBCONTRACTING AGREEMENT
(Sub-Clause4.4)

Date :
Project:

To
The Managing Director
DFCCIL

Dear Sirs

In accordance with the Sub-clause 4.4 of General Conditions of Contract read along with the Particular Conditions of Contract, we enclose this Memorandum of Understanding to enter into a subcontracting agreement between the Contractor _____and the Sub-contractor _____ to undertake the following:

1. Whereas the Employer requires the work of the project to be executed by the Contractor, and has accepted a bid by the Contractor for the execution and completion of the Works, and remedying any defects therein, the Contractor and the Subcontractor shall provide a formal agreement to the Employer prior to signature of Contract between the Employer and the Contractor.

2. The scope of work to be undertaken by the Sub-contractor is described as:

3. The work undertaken by the Sub-contractor does not relieve the Contractor from any liability or obligation under the Contract, and the Contractor shall, at all times, be solely responsible for the acts, defaults, and neglects of the Sub-contractor, his agents, servants and workmen as if anywhere the acts, defaults, neglects, of the Contractor, his agents, servants or workmen.

4. The Contractor shall provide insurance for the Subcontractor to the same level as his own insurance to include the Works executed under the subcontract agreement to be executed, and for the subcontractor's equipment as listed in Attachment to this MOU.

5. The Employer shall consider and approve the provisions of a signed subcontracting agreement prior to signature of Contract with the Contractor, as a reason for disqualifying the Contractor. The Employer shall also consider the non-fulfillment of any of the subcontract agreement terms as a reason for termination of the Contract, and upon 14 day's notice require the Contractor to vacate the Site. After such termination of the Contract by the Employer, the Employer may complete the work and or arrange any other authorities to do so.

Signed on this _____ day of _____month_____ year.

The Contractor
(Signature & Seal)

The Subcontractor
(Signature &Seal)

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SUB-CONTRACTOR'S WARRANTY

(Sub-Clause 4.4)

THIS AGREEMENT is made the day of

BETWEEN:

1. [ ] [whose registered office is at]/[of][ ] ("the Sub - contractor")and

2. The Dedicated Freight Corridor Corporation of India Limited (together with its successors and assigns, "the Employer")of:

5th Floor, Supreme Metro Station,
New Delhi,
India 110001.

WHEREAS

(A) By a contract ----------dated[ ] ("**the Contract**") made between (1) Dedicated Freight Corridor Corporation India Limited ("the Employer")

and (2)[ ] ("the Contractor"), the Contractor has agreed to design, execute, complete, test and commission (including integrated testing and commissioning) and remedy any defects in works upon the terms and conditions contained in the Contract.

(B) The Sub-contractor has had an opportunity of reading and noting the provisions of the Contract (other than details of the Contractor's prices and rates).

(C) Pursuant to the Contract, the Contractor proposes to enter into an agreement with the Sub- contractor ("the Sub-contract") for the Sub-contractor to carry out and complete a part of the Works as more particularly described in the Sub-contract ("**the Sub-contract Works**").

(D) The Contract stipulates that the Contractor shall obtain the consent of the Engineer before entering into the Sub-contract, and that the Contractor shall procure that the Sub-contractor executes a warranty agreement ("**Warranty**") in favour of the Employer.

NOW IT IS HEREBY AGREED as follows:-

1 In consideration of the Engineer consenting to the Contractor and the Sub-contractor entering into the Sub-contract, the Sub-contractor warrants and undertakes to the Employer that:

(a) he will execute and complete the Sub-contract Works, and will carry out each and all of the obligations, duties and undertakings of the Sub-contractor under the Sub-contract when and if such obligations, duties and undertakings shall become due and performable, in accordance with the terms of the Sub-contract (as the same may from time to time be varied or

amended with the consent of the Employer);and

(b) he will supply to the Contractor and in specific cases wherever required to the Engineer with all information as may be required from time to time in relation to progress of the Sub-contract Works.

2 The Sub-contractor undertakes to indemnify the Employer against each and every liability which the Employer may have to any person whatsoever and against any claims, demands, proceedings, loss, damages, costs and expenses sustained, incurred or payable by the Employer provided that the Sub-contractor shall have no greater liability to the Employer by virtue of this Warranty than the liability of the Contractor to the Employer under the Contract insofar as and to the extent that the same has arisen by reason of any breach by the Sub- contractor of his obligations under the Sub-contract.

3 No allowance of time by the Employer hereunder or by the Contractor under the Sub-contract nor any forbearance or forgiveness in or in respect of any matter or thing concerning this Warranty or the Sub-contract on the part of the Employer or the Contractor, nor any thing that the Employer or the Contractor may do or omit or neglect to do, shall in any way release the Sub-contractor from any liability under this Warranty.

4 The Sub-contractor agrees that he will not without first giving the Employer, not less than 21 day's prior notice in writing, exercise any right he may have to terminate the Sub-contract or treat the same as having been repudiated by the Contractor or withhold performance of its obligations under the Sub-contract.

5 (i) In the event that the Contract or the employment of the Contractor under the Contract is terminated for any reason whatsoever and if so requested by the Employer in writing within 21 days of such termination, the Sub-contractor shall carry out and complete his obligations under this Warranty and shall enter into a novation agreement with the Employer and the Contractor in which the Sub-contractor will undertake inter alia to perform the Sub-contract and be bound by its terms and conditions as if the Employer had originally been named as a contracting party in place of the Contractor. The said novation agreement will be in such form as the Employer may reasonably require.

(ii) In the event that the Employer does not require the Sub-contractor to enter into a novation agreement as required by Sub-clause 5(i), the Sub-contractor shall have no claim whatsoever against the Employer for any damage, loss or expense howsoever arising out of or in connection with this Warranty.

6 Insofar as the copyright or other intellectual property rights, in any plans, calculations, drawings, documents, materials, know-how and information relating to the Sub-contract Works shall be vested in the Sub-contractor, the Sub-contractor grants to the Employer, his successors and assignees a royalty free, non-exclusive and irrevocable license (carrying the right to grant sub-licenses) to use and reproduce any of the works designs or inventions incorporated and referred to in such documents or materials and any such know-how and information for all purposes relating to the Works of the Employer, without limitation the design, manufacture, installation, reconstruction, completion, reinstatement, extension, remedy of any defect of the Works. To the extent beneficial ownership of any such copyright or other intellectual property right is

vested in anyone other than the Sub-contractor, the Sub- contractor shall use best endeavors to procure that the beneficial owner thereof shall grant a like license to the Employer. For the avoidance of doubt, any such license granted shall not be determined if the Sub-contractor shall for any reason cease to be employed in connection with the Sub-contract Works.

7 In the event of any ambiguity or conflict between the terms of the Sub-contract and this Warranty, the terms of this Warranty shall prevail.

8 The provisions of this Warranty shall be without prejudice to and shall not be deemed or construed so as to limit or exclude any rights or remedies which the Employer may have against the Sub-contractor whether in tort or otherwise.

9 Nothing contained in this Warranty shall vary or affect the Sub-contractor's rights and obligations under the Sub-contract.

10 The Employer shall be entitled to assign the benefit of this Warranty at any time without the consent of the Sub-contractor being required.

11 All documents arising out of or in connection with this Warranty shall be served:

(1) upon the Employer at[ ] , marked for the attention of [ ];

(2) upon the Sub-contractor, at [ ]India.

12 The Employer and the Sub-contractor may change their respective nominated addresses for service of documents to another address in India but only by prior written notice to each other. All demands and notices must be in writing.

13 This Warranty shall be governed by and construed according to the laws for the time being in force in India.

14 (i) Any dispute or difference of any kind whatsoever between the Employer and the Sub-contractor arising under out of or in connection with this Warranty shall be referred to Arbitration in accordance with the Arbitration procedure as described in the Contract.

(ii) In the event that the Employer is of the opinion that the issues in such a dispute or difference will or may touch upon or concern a dispute or difference arising under out of or in connection with the Contract ("the Contract Dispute") then provided that an arbitrator has not already been appointed pursuant to Clause 20, the Employer may by notice in writing to the Sub-contractor require and the Sub-contractor shall be deemed to have consented to the referral of such dispute or difference to the arbitrator to whom the Contract Dispute has been or will be referred.

(iii) Save as expressly otherwise provided, the Arbitrator shall have full power to open up, review and revise any decision, opinion, instruction, notice, order, direction, withholding of approval or consent, determination, certificate, statement of objection, assessment or valuation by the Employer's Representative or the Contractor relating to the dispute or difference.

(iv) This Warranty shall be governed by and construed according to the laws

for the time being in force in India and the Sub-Contractor agrees to submit to the jurisdiction of the courts of Delhi/New Delhi.

IN WITNESS whereof this Warranty has been executed as a deed on the date first before written.

THE COMMON SEAL of

[ ]

was affixed hereto in)

the presence of:-)

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FORM OF DESIGNER'S WARRANTY

(Sub-Clause 5.1 and Sub-Clause 18.5)

THIS AGREEMENT is made the day of
BETWEEN:

(1) [ ] [whose registered office is at]/[of] [ ]("the Designer"); and

(2) The Dedicated Freight Corridor Corporation of India Limited (together with its successors and assigns, "the Employer")of

5th Floor, Supreme Court Metro
Station, New Delhi,
India 110001.

WHEREAS:

(a) By a contract ---------dated[ ] ("the Contract") made between (1) Dedicated Freight Corridor Corporation India Limited ("the Employer") and(2)[ ] ("the Contractor"), the Contractor has agreed to design, execute, complete, test and commission (including Integrated Testing and Commissioning) and remedy any defect in the Works upon the terms and conditions contained in the Contract.

(b) The Designer has had an opportunity of reading and noting the provisions of the Contract (other than details of the Contractor's prices and rates).

(c) Pursuant to the Contract, the Contractor wishes to enter into an agreement with the Designer and Designer agrees to the wishes of the Contractor (the Consultancy agreement) to carry out the Contractor's obligations under the Contract in relation to the design and functions ascribed to the Designer in the Contract.

(d) The Contract stipulates that the Contractor shall ensure that the Designer executes a warranty agreement ("**Warranty**") in favour of the Employer.

NOW IT IS HEREBY AGREED as follows:

1 In consideration of the Employer not objecting to the Contractor and the Designer entering into the Consultancy Agreement, the Designer warrants and undertakes to the Employer that he has exercised and will continue to exercise all the skill and care to be expected of a professionally qualified and competent designer experienced in work of similar nature and scope as the Works in carrying out the design of the temporary and Permanent Works and in performing the other duties and functions ascribed to him in the Contract.

2 The Designer agrees that, in the event of the termination of the Contract by the Employer or its appointee, the Designer will, if so required by notice in writing given by the Employer, accept subject to Clause 4 given herein, the instructions of the Employer or his appointee to the exclusion of the Contractor in respect of the carrying out and completion of the Works upon the terms and conditions of the Consultancy Agreement.

3 The Designer further agrees that he will not, without first giving the Employer not less than 21 days' previous notice in writing, exercise any rights it may have to terminate the Consultancy Agreement or to treat the same as having been as repudiated by the Contractor or to discontinue the performance of any duties to be performed by the Designer pursuant thereto. The Designer's right to terminate the Consultancy Agreement or to treat the same as having been repudiated or to discontinue the performance thereof shall cease if, within such period of notice and subject to Clause 4, the Employer shall give notice in writing to the Designer requiring the Designer to accept the instructions of the Employer or his appointee to the exclusion of the Contractor in respect of the carrying out and completion of the Contract Works upon the terms and conditions of the Consultancy Agreement.

4 Any notice given by the Employer under Clause 2 or 3 above shall state that the Employer or his appointee accepts liability for payment of the fees payable to the Designer under the Consultancy Agreement and for performance of the Contractor's obligations under the Consultancy Agreement, including payment of any fees outstanding at the date of such notice.

5 The Employer shall be entitled to assign the benefit of this Warranty at any time without the consent of the Designer being required.

6 All documents arising out of or in connection with this Warranty shall be served:

(1) upon the Employer at [ ] marked for the attention of [ ];

(2) upon the Designer at[ ].

7 The Employer and the Designer may change their respective nominated addresses for service of documents to another address in India but only by prior written notice to each other. All demands and notices must be in writing.

8 This Warranty shall be governed by and construed according to the laws for the time being in force in India.

9 (i) In the event that the Contract or the employment of the Contractor under the Contract is terminated for any reason whatsoever and if so requested by the Employer in writing within 21 days of such termination, the Designer shall carry out and complete his obligations under this Warranty and shall enter into a novation agreement with the Employer and the Contractor in which the Designer will undertake inter alia to perform the Design and be bound by its terms and conditions as if the Employer had originally been named as a contracting party in place of the Contractor. The said novation agreement will be in such form as the Employer may reasonably require.

(ii) In the event that the Employer does not require the Designer to enter into a novation agreement as required by Sub-clause 9 (i), the Designer shall have no claim whatsoever against the Employer for any damage, loss or expense howsoever arising out of or in connection with this Warranty.

Except to the extent (if any) expressly permitted by the Consultancy Agreement, the Designer shall not sub-contract any of the Designer's obligations under the

Consultancy Agreement without the prior written consent of the Engineer.

10 Without prejudice to its obligations under this Warranty, the Designer shall maintain with well established underwriters of repute and on terms and conditions reasonably acceptable to the Employer, professional indemnity insurance (as per sub-clause 18.5 of the Particular Conditions of Contract) in respect of the Designer and its sub-consultants for Indian Rupees Twenty Five Crore (25,00,00,000 Rupees) in relation to his design of the Works for any one occurrence or series of occurrences arising out of any one event from the date of notification of acceptance until 3 years after the issue of Performance Certificate for the whole of works. The Designer shall immediately inform the Employer if for any reason professional indemnity insurance is not maintained in accordance with this Warranty or becomes void or unenforceable.

11 Insofar as the patent, copyright or other intellectual property rights in any Design Data (as defined in the Contract), plans, calculations, drawings, documents, materials, computer software, know-how and information relating to the Works shall be vested in the Designer, the Designer grants to the Employer his successors and assigns a royalty-free, non-exclusive and irrevocable license (carrying the right to grant sub-licenses) to use and reproduce any of the works designs or inventions incorporated and referred to in such documents or materials and any such know-how and information for all purposes relating to the Works (including without limitation the design, construction, reconstruction, completion, reinstatement, extension, repair and operation of the Works). To the extent beneficial ownership of any such patent, copyright or other intellectual property right is vested in anyone other than the Designer or the Contractor, the Designer shall use his best endeavors to procure that the beneficial owner thereof shall grant a like license to the Employer. Any such license granted shall not be determined if the Designer shall for any reason cease to be employed in connection with the Works.

12 (i) Any dispute or difference of any kind whatsoever between the Employer and the Designer arising under out of or in connection with this Warranty shall be referred to arbitration in accordance with Clause20 of GC “Dispute” as defined in the Contract shall be deemed to include any such dispute or difference between the Employer and the Designer.

(ii) In the event that the Employer is of the opinion that the issues in such a dispute or difference will or may touch upon or concern a dispute or difference arising under out of or in connection with the Contract ("the Contract Dispute") then provided that an Arbitrator has not already been appointed, the Employer may by notice in writing to the Designer require and the Designer shall be deemed to have consented to the referral of such dispute or difference to the Arbitrator to whom the Contract Dispute has been or will be referred.

(iii) Save as expressly otherwise provided, the Arbitrator shall have full power to open up, review and revise any decision, opinion, instruction, notice, order, direction, withholding of approval or consent, statement of objection, determination, certificate, assessment or valuation by the

Engineer or the Contractor, relating to the dispute or difference.

(iv) This Warranty shall be governed by and construed according to the laws for the time being in force in India and the Designer agrees to submit to the jurisdiction of the courts of Delhi/New Delhi.

IN WITNESS whereof this Warranty has been executed as a deed on the date first before written.

THE COMMON SEAL of
[Designer
] was affixed
hereto in the
presence of:-

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Insurance Requirements
[Sub Clause- 18]

Insurance to be taken by the Contractor

In accordance with the provision of GC Clause 18, the Contractor shall at its expense take out and maintain in effect, or cause to be taken out and maintained in effect, during the performance of the Contract, the insurances set forth below in the sums and with the deductibles and other conditions specified. The identity of the insurers and the form of the policies shall be subject to the approval of the Employer, such approval not to be unreasonably withheld.

(A) Insurance of Works and Contractor's equipment-

In accordance with the provision of sub clause 18.2 contractor shall insure to cover loss or damage to works, plants, materials and contractor's documents occurring prior to completion of the facility until the date of issue of the performance certificate.

Amount (in currency(ies))	Deductible limits ((in currency(ies))	Parties insured (names)	From	To
As per GCC/ PCC/Appendix to Tender	-	Contractor and Employer	Commencement Date	Issue of Performance certificate

(B) Insurance against Injuries to Person and Damage to property

Covering any loss, damage, death or bodily injuries which may occur to any physical property or to any person covering loss and damage to Employers property and Employer's personal.

Amount (in currency(ies))	Deductible limits ((in currency(ies))	Parties insured (names)	From	To
As per GCC/PCC/ Appendix to Tender	-	Contractor and Employer	Commencement Date	Issue of Performance certificate

(C) Automobile liability Insurance

Covering use of all vehicle used by the contractors or its sub-contractors (whether or not owned by them) in connection with the design, construction testing and commissioning of the facilities under the contract in accordance with statutory requirements.

(D) Workers' Compensation

In accordance with the statutory requirements applicable in any country where

the facilities or any part thereof is executed.

(E) Professional Indemnity Insurance-
To cover professional negligence in the design of the Works.

Amount (in currency(ies))	Deductible limits ((in currency(ies))	Parties insured (names)	From (Place)	To (Place)
As per GCC/ PCC/Appendix toTender	-	Contractor and Employer	Commencement Date	3 Years beyond defect liability period

Insurance to be taken by the Employer – Nil

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STANDING INDEMNITY BOND FOR 'ON ACCOUNT' PAYMENTS

(On requisite Stamp value)

We, M/s._____hereby undertake that we held at our stores depots at_____for and on behalf of the Dedicated Freight Corridor Corporation of India Limited acting in the premises through the Managing Director or his Successor _____here under referred to as 'the Purchaser') all materials for which 'On Account' payments have been made to us against the contract for: BALANCE WORKS OF DESIGN, SUPPLY, CONSTRUCTION, TESTING AND COMMISSIONING OF SIGNALLING,TELECOMMUNICATION AND ASSOCIATED WORKSOF DOUBLE TRACK RAILWAY LINES UNDERCONSTRUCTION ON A DESIGN BUILD LUMP SUM BASIS FOR DEEN DAYAL UPADHYAY - NEW BHAUPUR SECTION OF EASTERN DEDICATED FREIGHT CORRIDOR' on_.DFCCIL also referred to as vide letter no. of Acceptance of Tender No._____dated_____and materials handed over to us by the Purchaser for the purpose of execution of the said Contract, until such time the materials are duly erected or otherwise handed over to him. We shall be entirely responsible for the safe custody and protection of the said materials against all risk till they are duly delivered as erected equipment to the purchaser, or as he may direct otherwise and shall indemnify the Purchaser against any loss, damage, or deterioration whatsoever in respect of the said materials while in our possession and against disposal of surplus materials. The said materials shall at all times by open to inspection by any officer authorized by the Managing Director, in-charge of the DFCCIL or his successor (Whose address will be intimated in due course).

Should any loss, damage or deterioration of materials occur or surplus materials disposed off and refund becomes due, the Purchase shall be entitled to recover from us the full cost as per prices included in Schedule–A to the Contract (As applicable) and in respect of other materials as indicated in Part 5, Schedule C, D & E and also compensation for such loss or damage, if any, along with the amount to be refunded without prejudice to any other remedies available to him by deduction form any sum due or any sum which at any time hereafter become due to us under the said or any other Contract.

Dated this_____day of_____202__
(For and on behalf of)

Messers_____(Contractor)

Signature of Witness

Name of Witness (In Block

letters) Address: