DELHI METRO RAIL CORPORATION LIMITED

(A Joint Venture of Govt. of India and GNCTD)

Name of Work: Contract DS-14: Design, Manufacture, Supply, Installation, Testing & Commissioning of Radio System for 3 Priority Corridors of Phase-IV of Delhi MRTS.

ADDENDUM NO. 03

SUMMARY SHEET

S. No	Bid Document	Page No.	Clause No. / Item No.	Addendum / Corrigendum
Invitation for Bids IFB				
1.	Invitation for Bids (IFB)	1RR	**Key Details Modified**	**"**Replace Page 1RR by 1RRR**"**.
Part 1: Bidding Procedures				
2.	Part-1 – Bidding Procedures Section II – BID DATA SHEET (BDS)	5R	Clause ITB-21.2 (Extension in Key Date)	**"**Replace Page 5R by 5RR".
3.	Part-1 – Bidding Procedures Section II – BID DATA SHEET (BDS)	6R	Clause ITB-24.1 & 27.1 (Extension in Key Date)	**"**Replace Page 6R by 6RR".
4.	Part 1: Bidding Procedures: Section IV – Bidding Forms - Annexure to Payment Schedule.	28	Cost Centre C - "SCC clause 48" may be read as "Additional Sub Clause 1 of PC Part B".	"Replace Page 28 by 28R".
Part 2: EMPLOYER'S REQUIREMENTS, GENERAL SPECIFICATIONS (GS)				
5.	**Part-2** General Specifications`	13	**Clause 1.12.1**	**"Table 1-1"** may be read as **"Table 1-2"**.
6.	**Part-2** General Specifications	14	**Clause 1.12.3**	**"Table 1-1"** may be read as **"table 1-2"**.
7.	**Part-2** General Specifications	21	**Clause 2.5.5**	**"Clause 3.5.11)"** may be read as **"clause 3.5.1(1)"**.
8.	**Part-2** General Specifications	22	**Clause 2.7.1**	**"Clause 2.4.27)"** may be read as **"clause 2.4.2(7)"**.
9.	**Part-2** General Specifications	23	**Clause 2.8.1**	**"Clause 2.4.27)"** may be read as **"clause 2.4.2(7)"**.
10.	**Part-2** General Specifications	23	**Clause 2.8.2**	**"Clause 9.3.22)"** may be read as **"clause 9.3.2(2)"**.
11.	**Part-2** General Specifications	32	**Clause 3.3.1 (6)(vi)**	**"Clause 6) iii)"** may be read as **"clause 3.3.1(6)(iii)"**.
12.	**Part-2** General Specifications	39	**Clause 3.5.2 (iv)**	**"Clause 3.5.13).iv).(a)"** may be read as **"Clause 3.5.1(3)(iv)(a)"**.

S. No	Bid Document	Page No.	Clause No. / Item No.	Addendum / Corrigendum
13.	**Part-2** General Specifications	41	**Clause 3.5.3(6)**	**"Clause 9.2.68)"** may be read as **"clause 9.2.7"**.
14.	**Part-2** General Specifications	51	**Clause 4.3.5(3)**	**"Clause 4.3.2.4)"** may be read as **"clause 4.3.2(4)"**.
15.	**Part-2** General Specifications	57	**Clause 5.7.2**	**"Clause 9.6.61)"** may be read as **"clause 9.6.6(1)"**.
16.	**Part-2** General Specifications	58	**Clause 5.9.1(4)**	**"Clause 5.9.1.1), 2) & 3)"** may be read as **"clause 5.9.1(1), (2) & (3)"**.
17.	**Part-2** General Specifications	70	**Clause 9.2.2**	**"Clause 5.5 above "** may be read as **"clause 5.5 above "**.
18.	**Part-2** General Specifications	79 & 80	**Clause 9.8.1**	**Para (2) is merged with Para (1)** and **Para (3) & Para (4)** may be read as **Para (2) & Para (3)** respectively.
19.	**Part-2** General Specifications	80	**Clause 9.8.3**	**"Clause 9.8.11)"** may be read as **"clause 9.8.1(1) "**.
20.	**Part-2** General Specifications	93	**Clause 13.3.1**	**"Clauses Error! Reference source not found and 0 below"** may be read as **"clauses 13.3.5 & 13.3.6 below"**.
21.	**Part-2** General Specifications	104	**Clause 16.3.9**	**"The ITT and the PS"** may be read as **"The PS "**.
22.	**Part-2** General Specifications	120	**Clause 19.4.7**	**"Clause Error! Reference source not found"** may be read as **"clause 19.4.6 above"**.
23.	**Part-2** General Specifications	130	**Clause 1.1**	**"Clause 2.17"** may be read as **"clause 2.18 "**.
24.	**Part-2** General Specifications	130	**Clause 1.1(4)**	**"Paragraph 2.19"** may be read as **"Paragraph 2.21"**.
25.	**Part-2** General Specifications	131	**Clause 1.2(4)**	**"Paragraph 2.18"** may be read as **"Paragraph 2.20"**.
26.	**Part-2** General Specifications	131	**Clause 1.2(5)**	**"Paragraph 2.17"** may be read as **"Paragraph 2.19"** and **"Paragraph 2.19"** may be read as **"Paragraph 2.21"**
Part 3: Conditions of Contract & Contract Forms				
27.	**Part-3** PC Part-A **Contract Data**	2	**Sub-Clause 1.2**	**"Not Included"** may be replaced with **"Deleted"**
Pricing Document - BOQ				
28.	Pricing Document	-	Item rate BOQ	**"BOQ replaced"**

Invitation for Bids (IFB)

Date: **27.12.2021**
Loan Agreement No.: ID-P296
IFB No.: Contract DS-14

1. The President of India has received a loan for an amount of JPY 119,978 Million from Japan International Cooperation Agency (JICA) towards the cost of Delhi Mass Rapid Transit System Project of Phase IV. It is intended that part of the proceeds of this loan will be applied to eligible payments under the Contract DS-14.
2. Bidding will be conducted through procedures in accordance with the applicable Guidelines for Procurement under Japanese ODA Loans, and is open to all Bidders from eligible source countries, as defined in the Loan Agreement.
3. Delhi Metro Rail Corporation Limited now invites online open e-tenders from eligible Bidders for the design, execution and completion of "Contract DS-14: Design, Manufacture, Supply, Installation, Testing & Commissioning of Radio System for 3 Priority Corridors of Phase-IV of Delhi MRTS" ("the Works"). Local Competitive Bidding (LCB) will be conducted in accordance with JICA's "Single-Stage Two-Envelope" Bidding Procedure.
4. Interested eligible Bidders may download the Bidding Documents after registration on the e-tendering website ***https://eprocure.gov.in/eprocure/app***.
5. Cost of the Bidding Documents shall be a non-refundable fee of INR 23,600/-* (inclusive of 18% GST).
6. Bids must be submitted online on the e-tendering website ***https://eprocure.gov.in/eprocure/app*** from ~~28.01.2022~~ ~~10.02.2022~~ **17.02.2022** (0900 hrs) to ~~07.02,2022~~ ~~21.02.2022~~ **02.03.2022** (**1500 hours**) and must be accompanied by a Bid Security of ~~7.70 million~~ **INR 77.0 Lacs**.
7. Bids will be opened on the e-tendering website ***https://eprocure.gov.in/eprocure/app*** at 1500 hrs on ~~08.02.2022~~ ~~22.02.2022~~ **03.03.2022**.
8. Key Details for Contract DS-14 are as follows:
   - Completion period of the Work: Thirty-Six (36) months
   - Sale of Bidding documents: From **27.12.2021** to ~~07.02.2022~~ ~~21.02.2022~~ **02.03.2022**
   - Pre-bid Meeting: 1100 hrs on **14.01.2022** as per BDS 7.4
   - Deadline for Bid submission: 1500 hrs on ~~07.02.2022~~ ~~21.02.2022~~ **02.03.2022** as per BDS 24.1
   - Technical Bid Opening date: 1500 hrs on ~~08.02.2022~~ ~~22.02.2022~~ **03.03.2022** as per BDS 27.1

**The instrument type for payment of cost of Bidding Documents shall be in the form of Demand Draft / Pay Order / Bank Draft in favour of "Delhi Metro Rail Corporation Ltd." payable at New Delhi from a Scheduled Commercial bank based in India or RTGS/ NEFT/ IMPS in the bank account of Delhi Metro Rail Corporation Limited as mentioned below.*

DMRC Ltd. Tender Cell Account No. 000705045337
ICICI Bank, 9A, Phelps Building, Connaught Place, New Delhi-110001
Account Type: Current, IFSC code: ICIC0000007

In case, the payment of cost of the Bidding Documents is in the form of Demand Draft / Pay Order / Bank Draft, it shall reach the office of Sr. General Manager/Contract at the address mentioned below before the deadline for Bid submission as per BDS 24.1.

ITB 20.1	The Bid validity period shall be 120 days.
ITB 20.3 (a)	Not Applicable.
ITB 20.3 (b)	The fixed portion of the Bid price (which has been considered as 30% of the Contract Price in Price Variation Formula) shall be adjusted by the following factor: **The fixed portion of the Contract Price in local currency shall be adjusted by a factor (Wpi– Wpio) / Wpio** Where, Wpio = Wholesale price index for All Commodities, as published in the RBI Bulletin for the previous month in which 56 days beyond the initial Bid validity period fall. Wpi = Wholesale price index for All Commodities, as published in the RBI Bulletin for the previous month in which the Bid was awarded. **The fixed portion of the Contract Price in foreign currency shall be adjusted by a factor [(X-Y)/X] x [(Wpi – Wpio) / Wpio]** Where, X = SBI Exchange Rate (Selling) in INR at 56 days beyond the initial Bid validity. Y = SBI Exchange Rate (Selling) in INR at the date of award of Contract.
ITB 21.1	The amount and currency of the Bid Security shall be **INR 7.70 million**
ITB 21.2	For submission of Bid Security in "Original", the Employer's address is Office of Sr. General Manager/Contract 5th floor, A - Wing, Metro Bhawan Fire Brigade Lane, Barakhamba Road New Delhi - 110 001 India The deadline for submission of Bid Security in "Original" is: Date: ~~07.02.2022~~ ~~21.02.2022~~ **02.03.2022** Time: 1500 hrs.
ITB 21.2 (d)	Other types of acceptable securities: None.
ITB 21.7	**Following Para is added:** The time duration for bidder to legally constitute into a legally enforceable JV is within twenty-eight (28) days of the receipt of the Letter of Acceptance from the Employer or before signing of contract agreement as per ITB 43
ITB 22.1	The Bidder shall submit the Technical Bid containing the documents listed in ITB 11.2 and the Price Bid containing the documents listed in ITB 11.3 on e-tendering website ***https://eprocure.gov.in/eprocure/app*** only.
ITB 22.2	The written confirmation of authorization to sign on behalf of the Bidder

	shall consist of: 1) The Bidder shall submit a written power of attorney, duly notarized, authorising the signatory(ies) of the Bid to commit the bidder along with Board Resolution confirming authority on the persons issuing the Power of Attorney for such actions. 2) In case of partnership, Consortium or Joint Venture, notarized Power of Attorney(s) and Board Resolution(s) for each member of the partnership, Consortium or Joint Venture shall be submitted. 3) In case of Foreign Partners, Power of Attorney(s) and Board Resolution confirming authority on the persons issuing the Power of Attorney for such actions shall be submitted duly notarized by the notary public of country of origin and should be either stamped by Embassy/High Commission or Member Countries of Hague convention may submit these documents with "Apostille" stamp. 4) In case the documents are in foreign language the translation of the same shall be authenticated by Embassy/High Commission.
D. Submission and Opening of Bids	
ITB 23.1	Bidders shall submit their Technical Bid and Price Bid on e-tendering website ***https://eprocure.gov.in/eprocure/app.***
ITB 23.2	Not Applicable
ITB 23.3	Not Applicable
ITB 23.4	Not Applicable
ITB 23.5	Not Applicable
ITB 24.1	Bidders shall submit their Technical Bid and Price Bid on e-tendering website ***https://eprocure.gov.in/eprocure/app***. The deadline for Bid submission is: **Date:** ~~07.02.2022~~ ~~21.02.2022~~ **02.03.2022** Time: 1500 hrs
ITB 26.1	Not Applicable
ITB 26.2	Not Applicable
ITB 26.3	Not Applicable
ITB 27.1	The Technical Bid shall be opened on e-tendering website ***https://eprocure.gov.in/eprocure/app*** The date and time for Opening of Technical Bids is: Date: ~~08.02.2022~~ ~~22.02.2022~~ **03.03.2022** Time: 1500 hrs
ITB 27.2	Not Applicable

Cost Centre C: Spares, Special Tools & Test Equipment

This cost center includes, but not limited to, the following for complete Contract:

1) Delivery of Contract Spares to Employer as per provisions of Contract.
2) Submission of List of Spares for 10 Years of system operation with unit price from the date of Taking over of whole works as per ~~SCC clause 48~~ **Additional Sub Clause 1 of PC Part B**
3) Delivery of Special Tools & Test Equipment to Employer as per provisions of contract
4) Any other item(s) considered necessary to comply with the scope of work.
5) This cost center comprises all the above obligations and related activities throughout the contract and not associated directly with any other Cost Centre.

This Cost Centre-C is further distributed in various Milestones as tabulated below:

Milestone No.	Milestone Description	Amount Payable (% of STM C)	
		LC	FC
	Obtain "No Objection" or "No Objection Subject to ---" from the Employer's Representative for the following for complete contract :		
STM-C1	Delivery of Contract Spares to Employer as per provisions of Contract and Submission of List of Spares for 10 Years of system operation with unit price from the date of Taking over of whole works as per ~~SCC clause 48~~ **Additional Sub Clause 1 of PC Part B**.	**80%**	**80%**
STM-C2	Delivery of Special Tools & Test Equipment to Employer as per provisions of contract.	**20%**	**20%**
	TOTAL	**100%**	**100%**

Cost Centre E: DLP Support

This cost center includes, but not limited to, the following for complete Contract:

1) Defect Liability Period (DLP) Support
2) Any other item(s) considered necessary to comply with the scope of work.
3) This cost center comprises all the above obligations and related activities throughout the contract and not associated directly with any other Cost Centre.

This Cost Centre-E is further distributed in various Milestones as tabulated below:

Milestone No.	Milestone Description	Amount Payable (% of STM D)	
		LC	FC
	Obtain "No Objection" or "No Objection Subject to ---"from the Employer's Representative for the following for complete contract :		
STM-E1	Defect Liability Period (DLP) Support	**100%**	**-**
	TOTAL	**100%**	**-**

DELHI METRO RAIL CORPORATION LIMITED

BIDDING DOCUMENTS

FOR

CONTRACT

(DS11, DS12, DS13, DS14, DS15 & DS16)

DESIGN, MANUFACTURE, SUPPLY, INSTALLATION, TESTING & COMMISSIONING OF SIGNALLING & TELECOMMUNICATIONS SYSTEM.

PART 2: EMPLOYER'S REQUIREMENTS

SECTION VI – PARTICULAR SPECIFICATIONS

GENERAL SPECIFICATIONS (GS)

DELHI METRO RAIL CORPORATION LTD.

5th Floor, A-Wing,

Metro Bhawan, Fire Brigade Lane,

Barakhamba Road, New Delhi –110 001

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CHAPTERS

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CHAPTER 1

1. GENERAL

1.1 Scope of the General Specifications (GS)

1.1.1 This Specification covers the general aspects of the tender viz., description of the Works, submittal requirements of Design & Drawings, Management Plans, Project Planning and Progress Monitoring, Site Management and Contractor's obligations for safety and health etc. This GS shall be read in conjunction with the other documents constituting the Contract.

1.1.2 The provisions contained in the GS shall prevail over the provisions contained in International Standards, European Standards, British Standards, Indian Standards, British Standard Codes of Practice and similar standard documents stated in the Contract.

1.1.3 The provisions contained in the Particular Specifications (PS) and the Employer's Drawings shall prevail over the provisions contained in this GS.

1.2 Abbreviations

Abbreviations used in the GS shall have the following meanings:

BS	: British Standard
CADD	: Computer Aided Design and Drafting
CAR	: Corrective Action Request
COTS	: Commercial Off the Shelf
CPM	: Critical Path Method
CV	: Curriculum Vitae
DLP	: Defects Liability Period
DMRC	: Delhi Metro Rail Corporation
DVT	: Design Verification Table
E&M	: Electrical & Mechanical
EMC	: Electromagnetic Compatibility
EMIP	: Environmental Mitigation Implementation Plan
EMP	: Environmental Management Plan
ETI	: Employer's Training Instructors
FAT	: Factory Acceptance Test(s)'
GC	: General Conditions
GCC	: General Conditions of Contract
GS	: General Specifications (this document)
HV	: High Voltage
IEC	: International Electro-technical Commission
IEE	: The Institution of Electrical Engineers
IP	: Ingress Protection
IS	: Indian Standards
ISO	: International Organisation for Standardization
ITT	: Instructions To Tenderers
ITU	: International Telecommunication Union
PC	: Particular Conditions
PS	: Particular Specification
PVC	: Polyvinyl Chloride
QA	: Quality Assurance

RAMS	: Reliability, Availability, Maintainability and Safety
RTU	: Remote Terminal Unit
SAT	: Systems Acceptance Test(s)
SCC	: Specific Conditions of Contract
SIL	: Safety Integrity Level
SQAP	: Software Quality Assurance Plan
SRR	: Submission Review Request
T/C	: Time Chainage
TRIP	: Track Related Installation Programme

Table 1-1: General Abbreviations

1.2.1 Further abbreviations may be defined within the body of the GS or PS where there is only local applicability. Where such abbreviations exist, the Contractor shall exercise great care that the abbreviation is not used out of context when communicating with the Employer, the Engineer or any Third Party.

1.3 Definitions

Words and phrases defined in the GC/GCC or PC/SCC shall retain the same meaning within the GS and PS unless specifically redefined within this GS.

1.3.1 **"Access Dates"** are dates that are to be achieved by other than the Contractor and which are considered to be essential to the successful completion of the Contract to the original planned schedule. A list of the activities completion of which are considered to give rise to an Access Date are included in the PS.

1.3.2 **"Commissioning"** means the process of setting to work the complete transportation system through a series of integrated tests that demonstrate the installation and performance in accordance with the specified criteria.

1.3.3 **"Day"** means calendar day.

1.3.4 "**Defined Area"** means an area within which Works Trains will be operated and the Employer's defined area working safety rules will apply.

1.3.5 **"Factory Acceptance Tests"** means the tests to be performed at the Contractor's factories prior to delivery to the Site to verify compliance with the Specification and quality standards

1.3.6 **"Installation Tests"** means the tests to be performed to verify the conformity of completion of an installation/assembly to the design documents previously reviewed without objection by the Employers Engineer prior to the start of Commissioning. Installation Tests do not form part of the Tests on Completion to be performed by the Contractor in order to achieve Employer's Taking Over of the Works or any Section however they must be successfully completed before the Tests on Completion can commence.

1.3.7 **"Key Dates"** are dates which are to be achieved by the Contractor and which are considered to be essential to the successful completion of the project to the original planned schedule. A list of the activities, completion of which gives rise to a Key Date, is included in the PS.

1.3.8 **"Partial Acceptance Tests"** means the functional tests to be performed on components and parts of systems to meet the specified criteria. Partial Acceptance Tests form part of the Tests on Completion to be performed under the Contract in order to achieve Employer's Taking Over of the Works or any Section.

1.3.9 **"Service Trial"** means the phase after completion of the System Acceptance Tests where the training and operating procedures are validated through the running of the trains to the published timetable. Service Trial form part of the Tests on Completion to be performed under the Contract in order to achieve Employer's Taking Over of the Works or any Section.

1.3.10 **"Quality Control Point"** means a point in time when a notice or other document is to be submitted to the Engineer in accordance with the Contract before the Contractor can commence, proceed with or terminate an activity

1.3.11 **"Quality Hold Point"** means a point in time when a notice of no objection by the Engineer is required.

1.3.12 '**S' curve"** means the graphical relationship between the planned (and actual where appropriate) quantity of completed work (or resources) and time. The curve produced is to be illustrated on an accumulative basis where the slope of the line indicates the rate of undertaking the work or rate of expenditure of the resources.

1.3.13 **"Specification (the)"** means the aggregate sum of the documents and any amendments thereto, issued to Tenderers by DMRC as part of the Tender process before the final date for submission of Tenders. This shall include but not be limited to; Design Criteria, Employer's Requirements, Employer's Tender Drawings, Preliminary Operating Plan and Clarification of Tender Documents issued in accordance with the ITT but shall not include the ITT itself nor any minutes of meetings.

1.3.14 **"Specification (this)"** means the particular document within which the reference is made.

1.3.15 **"System Acceptance Tests"** means those tests that demonstrate the performance of the installation/equipment to the specified requirements as detailed in the PS. SATs form part of the Tests on Completion to be performed under the Contract in order to achieve Employer's Taking Over of the Works or any Section.

1.3.16 **"Integrated Testing and Commissioning"** means those tests that demonstrate the integration of the complete transport system meeting the requirements of the Specification in an operating environment. Integrated Testing and Commissioning form part of the Tests on Completion to be performed by the Contractor in order to achieve Employer's Taking Over of the Works or any Section.

1.3.17 **"Validation"** means the process of confirmation by examination and provision of objective evidence that the application produced achieves the particular requirements specified.

1.3.18 **"Verification"** means the process of confirmation by examination and provision of objective evidence that the specified requirements have been incorporated within design.

1.4 Glossary of Terms

1.4.1 Words and expressions to which meanings are assigned in any paragraph of the GS shall have the same meanings in other paragraphs of the GS except when the context otherwise requires.

1.4.2 Utilities are electricity, lighting, traffic control, telephone and other communication cables, gas, water, sewage and drainage pipes and ducts, including all associated protection, supports, ancillary structures, fittings and equipment.

1.5 Submission for Review

1.5.1 Reference of the GS and PS in any submission made by the Contractor to the Engineer having been reviewed without objection by the Engineer shall mean the issue of a notice of no objection by the Engineer issued in response to a submission made by the Contractor. Documents, drawings, specifications, calculations, technical papers, material samples, methods of construction and any other matters which have been reviewed without objection by the Engineer shall not be changed without further submission for review to the Engineer of the proposed changes.

1.5.2 Clause 4.2 below prescribes the process to be adopted for submissions of documents, material samples and any other items to the Engineer. Schedules of items that are to be submitted to the Engineer for review are contained within this GS and/or the PS.

1.5.3 Submissions for review shall be made in accordance with the dates (relative to the Works Programme) stated in the GS and/or the PS, or in accordance with Appendix 4 of this Specifications. For items not specifically given a submission date in the Specification submissions shall be strictly in accordance with the agreed Submissions Programme or as directed by the Engineer.

1.6 Standards, Codes of Practice

1.6.1 Unless otherwise stated in the Contract, reference in the GS to International Standards, European Standards, British Standards, British Standard Codes of Practice and similar standards shall be to that edition of the document stated in the PS, including all latest amendments issued by the relevant authority. In the event that no specific edition reference is given, the current edition as at the date of issue of the Letter of Acceptance shall apply.

1.6.2 Later editions of International Standards, European Standards, other national or international Standards or Codes of Practice and other similar standards, or standards which are considered to be equivalent, shall not apply unless reviewed without objection by the Engineer. The Engineer shall give or withhold his notice of no objection after the Contractor has provided him with a copy of the relevant standard for information. If a notice of no objection is given, the Contractor shall provide two copies of the document for use by the Engineer.

1.6.3 Permanent Works, Temporary Works, Contractor's Equipment, hardware, firmware, software, apparatus of all kinds, and, where appropriate, materials and workmanship shall be in accordance with the Standards quoted in the Specification and the requirements identified in the PS.

1.6.4 Where no Standard is identifiable, the Contractor shall make a proposal which shall be subject to review by the Engineer.

1.6.5 During the preliminary design phase, the Contractor shall submit a consolidated list of all the standards that he intends to use for the design, manufacturing and testing and other phases of the contract, for review of the Engineer.

1.6.6 During the design phase, the Contractor shall provide original copies of the standards used/referred, English version (if not available translation shall be made available) as part of the Contract.

1.6.7 The standards shall be provided in electronic format (soft copy). However, in case the same is not available, with the Engineer's consent, original printed copy can be provided.

1.7 Employer's Drawings

1.7.1 The Employer's Drawings assist in describing the scope of the Works in general and clarify constraints, interface arrangements and the conceptual nature of the finished structures/system outline.

1.7.2 The Contractor shall carefully check all Employer's Drawings and advise the Engineer of discrepancies, omissions, errors or ambiguities should any be found.

1.7.3 The Contractor shall note that any drawings included but marked "For information only" do not form part of the Contract.

1.7.4 Dimensions shall not be obtained by scaling from the Employer's Drawings. Dimensions that are not shown or are not calculable from dimensions shown on Employer's Drawings shall be obtained from the Engineer.

1.8 Units

1.8.1 Abbreviations of units of measurement used in the GS shall have the meanings as defined under the SI system of units.

1.8.2 Specifications in imperial units shall not be substituted for specifications in metric units stated in the Contract without the prior consent of the Engineer.

1.8.3 Conversion of metric units to imperial units and of imperial units to metric units shall be in accordance with the Standard International Practice.

1.9 System Safety

1.9.1 Safety philosophy

1) Safety of passengers, staff and the general public is paramount for railway operation. Prime consideration shall be given to all design issues that can have an effect on safety.

2) During the construction phase the safety of all staff involved in the Works and any members of the general public affected by the Works shall be the prime feature of all working methods, including storage and transport to site as well as all temporary works not incorporated into the final construction.

1.9.2 Safety Management

The Contractor shall implement the Contract Systems Safety Management Requirements, as referenced in the Safety, Health and Environment Management Manual and elsewhere in the Specification, in consultation with the Engineer.

1.9.3 Prescriptive Safety Criteria

1) The Contractor shall identify and list all applicable statutory and regulatory requirements and codes of practice relevant to the design of the Works undertaken and to work within the constraints and limitations imposed by the requirements and codes.

2) The safety of the Contractor's supplied systems and equipment shall be developed by the Contractor in accordance with the requirements contained in clause 3.4.5 below and the PS.

1.10 Reliability, Availability and Maintainability

1.10.1 The reliability and maintainability of the Permanent Works shall be developed by the Contractor in accordance with the requirements contained in clause 3.4 below and the PS.

1.10.2 The Contractor shall prepare Availability and Maintainability plans as detailed in European standard EN 50126. The first draft of these plans shall be submitted to the Engineer for review within 6 months of the Commencement Date of the Works.

1.11 Suitability for Purpose

Delhi Metro Rail Corporation (DMRC) shall be operating high-density passenger trains with high volume of traffic in the proposed corridors commensurate with the stage opening of the sections.

1.11.1 Interference and Compatibility

The Contractor shall ensure that all Works and Contractor's Equipment operate in a satisfactory manner without causing interference to other equipment and services including parties external to the Employer. The Contractor shall also ensure that the Permanent Works are physically and technically compatible with associated plant and in particular with that of other Contractors.

1.11.2 Design for introduction to service

The Permanent Works shall be designed in such a manner that they can be installed, tested and commissioned without adversely affecting the operation or safety of the Project. The Permanent Works shall be designed so that, where appropriate, considering the operating procedures adopted by the Employer, they can be brought into operational use during non-traffic hours and if necessary, during a single night following maintenance, repair or overhaul during the life of the Permanent Works, equipment and systems.

1.12 Climatic Conditions / Operating Environment

1.12.1 General

The following information on climatic conditions in Delhi 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.

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 1-2. Certain parts of the Permanent Works may need to be rated for more or less onerous conditions as required by the PS.

Clause 1.12.3 below gives the different classifications of environment to be encountered. For any type of item, examples of which are installed in more than one environmental class, all examples of the type shall be suitable for installation in the most severe environmental class conditions encountered by any example of the type.

1.12.2 The Contractor's attention is drawn to the more severe environmental conditions that may exist during the construction 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.

Air throughout the Project will contain considerable moisture content and the atmosphere will be corrosive. The Permanent Works shall be tropicalised and vermin proof.

While designing the Works, Contractor shall take into account of the specific environmental conditions viz. sulphation in Air, Corrosive fumes from industrial units/ drainages etc. in the vicinity of the permanent works. Suitable provisions such as conformal coating on cards must be provided by contractor to avoid damage to Cards due to environmental conditions.

The indicative information on climatic conditions in Delhi is derived from the India Meteorological Department publication "Climate of Haryana and Union Territories of Delhi and Chandigarh-1991. The data covers the period 1901 to 1980.

1.12.3 Classification of Equipment Environment

The locations at which equipment may be installed have been divided into four environmental classes as shown in table 1-2. The classes of environment are considered to become more extreme from A to D.

CLASS	LOCATION of EQUIPMENT
A	Air-Conditioned Offices, Computer and Equipment Rooms
B	Ventilated Equipment Rooms in buildings at the surface or at the underground station or structures.
C	Train Tunnels
D	Outdoors

Table 1-2: Classes of Environment

1.12.4 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.

1) **Requirements for Class A**

Minimum Temperature	5°C
Ambient Temperature	25°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.

2) **Requirements for Class B**

Ambient Temperature	30°C
Maximum Temperature	45°C
Relative Humidity	Nominal 70%, Maximum 100% (Non-Condensing)
Electrical Noise	Impulse 1kV, 1.2/50 rise/decay, 500Ohm source impedance, 0.5 J source energy. Radio & High frequency as Class A
Air Quality	Polluted and dusty - SO_2: 80-120mg/m^3 Suspended Particulate Matter: 360-540mg/ m^3

3) **Requirements for Class C**

Ambient Temperature	46°C
Maximum Temperature	60°C
Electrical Noise	Impulse 5kV, otherwise as Class B.

4) **Requirements for Class D**

i) Temperature

All equipment shall be designed and tested in accordance with the given figured 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; particular attention shall be paid to the possibility of solar gain.

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

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

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

WINTER	Nov	Dec	Jan	Feb
	°C	°C	°C	°C
Max:	28.7	23.4	21.3	23.6
Min:	11.8	8.0	7.3	10.10
SUMMER	March	Apr	May	June
	°C	°C	°C	°C
Max:	30.2	36.2	40.5	39.9
Min:	15.1	21	26.6	28.7
RAINY	Jul	Aug	Sep	Oct
	°C	°C	°C	°C
Max:	35.3	33.7	34.1	33.1
Min:	27.2	26.1	24.6	18.7

ii) Rain Fall

Maximum recorded daily total rainfall per 24 hrs : 495.3 mm (1875)
Monthly average total rain fall (during rainy season)

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

iii) Wind Pressure

The system is to be designed to give satisfactory service for a wind pressure up to 150 kg/m^2.

iv) Sunshine

Monthly average sunshine hours can be obtained by placing a specific request to Meteorological Department.

v) Relative Humidity

Daily maximum and minimum average values during winter, summer and rainy season.

Seasons	Max	Min
Winter (November to February)	72%	28%
Summer (March to June)	48%	16%
Rainy (July to October)	77%	35%

5) **Electromagnetic Compatibility (EMC)**

Electronic equipment in a railway environment shall be immunised against the usual electromagnetic influences to be expected from the rail operations. For this, the following EMC classification in accordance to IEC 61000 or similar, for the equipment rooms shall be achieved:

i) Electrostatic discharge

The electronic equipment rooms shall be designed in accordance to class 2 of IEC 801-2 or similar.

ii) Electromagnetic fields

The electronic equipment rooms shall be designed in accordance to class 2 of IEC 801-3 or similar.

iii) Fast transient interference (Burst)

The electronic equipment rooms shall be designed in accordance to class 2 of IEC 801-4 or similar.

iv) High energy transient interference

The electronic equipment rooms shall be designed in accordance to class 2 of IEC 801-5 or similar.

v) Switching processes in high-voltage installations

The location of computer systems in the neighbourhood < 1m of high-voltage installations, such as medium voltage or transformer stations as well as direct parallel exposure of power and data cables should be avoided.

vi) Magnetic fields

The following magnetic field strengths at the place of installation of cathode ray tube (CRT) based visual display units (VDU) should not be exceeded:

DC fields: 10 A/m or 12 µT

AC fields: 1 A/m or 1.2 µT

If the image quality is impaired by values exceeding the above the Contractor shall provide any necessary shielding or alternative corrective measures to restore the picture quality. Note: flat screen VDU using LED technology or similar may be acceptable if a sufficiently high resolution and image size can be obtained.

6) **Survey and Site Investigations**

i) For reference to surveys external to the Contract, the Contractor shall refer all Levels to Mean Sea Level (MSL) Datum, which is that generally used throughout Delhi.

ii) The datum used for the Contract shall be Mean Sea Level Datum.

iii) The Contractor shall carry out all further site investigations necessary for the design of the Permanent Works and to enable the determination of the methods of construction and the nature, extent and design of Temporary Works.

iv) The Contractor shall investigate environmental factors also to determine suitable methods of manufacture and installation, both for Temporary and Permanent Works. In particular the Contractor shall ensure that the dusty environment of Delhi has no detrimental effect to the functionality, reliability or long term maintainability of the Permanent Works.

* End of Chapter *

CHAPTER 2

2. PLANNING, PROGRAMME AND PROGRESS MONITORING

2.1 Planning

2.1.1 The Contractor shall develop in detail, a logical method of executing the Works taking into account their complex nature and different phases and shall provide programmes which reflect the detailed planning undertaken.

2.1.2 The programmes shall start with the Commencement Date of the Works as day one, are to be realistic, achievable and shall be accompanied by the detailed supporting Plans referred to in Chapter 3 below.

2.2 Programming General Requirements

2.2.1 Programme activities shall be discrete items of work, which when combined, produce definable elements, components, Milestones, Stages and Sections of the Works and clearly identify the completion obligations of the Contractor.

2.2.2 Design programmes shall be organised by Design Stages and Plans as described in clause 3.5.1 below.

2.2.3 Key Dates and Milestones shall be an integral part of all programmes and all activities, and sequencing and interrelationships required to achieve each completion obligation shall be shown. Milestones shall not impose constraints that in any way affect the programme logic and float or limit the achievement of Key Dates. Milestones shall not be introduced into any programme as constrained dates.

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

2.2.5 Activity descriptions shall clearly convey the nature and scope of the Works. Programmes shall take into account the activities of precursor, concurrent, adjacent and follow on Project Contractors as well as utility service diversions, new utilities and connections and any other activity that may affect the progress of the Works.

2.2.6 The Contractor shall also incorporate the Engineer's requirements for additional activities, to further explain or subdivide complex or long duration tasks, without affecting completion dates.

2.3 Progress Monitoring

The Contractor shall monitor its and its subcontractors' performance against programmes to ensure its compliance with its obligations under the Contract. Monitoring of the Works shall include direct, daily monitoring of the progress of the Works and the preparation of written and computerised reports to be submitted to the Engineer. The reports shall include all necessary supporting data to apprise the Engineer of the status of the completion of the Works as described in clause 2.18 below.

2.4 Works Programme

The Works Programme to be submitted under the Contract shall be developed from the Outline Works Programme submitted and developed during the Tender period. Similarly, the Design

Submission Programme shall be developed from the Outline Design Submission Programme submitted and developed during the Tender period.

2.4.1 **Submission Dates**

1) Within 28 days of the Commencement Date of the Works, the Contractor shall submit for review by the Engineer, his proposed Works Programme which shall provide full programme details for the first six months of the Contract and shall provide outline details for the remaining period of the Contract.

2) Should the Contractor fail to submit the Works Programme within the timescales nominated above, the Employer may nominate the Outline Works Programme as the first issue of the Works Programme required under the Contract.

3) In the event that the Employer does nominate the Outline Works Programme as the first issue of the Works Programme under the Contract, the Engineer may include any amendments that he sees fit to change external constraining dates, duration of activities by parties other than the Contractor and subdivide the Contractors own activities to provide additional detail and links to other activities but without altering the duration or sequencing of the activities shown on the Outline Works Programme.

4) Works Programme resulting from a nomination by the Employer of the Outline Works Programme as amended shall be taken by the Contractor as his own work and any responsibility for further maintenance of the Works Programme as nominated shall remain the Contractor's.

5) In compiling its Works Programme, and in all subsequent up-dating and reporting, the Contractor shall make provision for the time required for co-ordinating and completing the design, testing, commissioning, and integrated testing of the Works, including *inter alia*, design co-ordination periods, during which the Contractor shall co-ordinate its design with those of Designated Contractors, the review procedures determining and complying with the requirements of Government Departments and all others whose consent, permission, authority or licence is required prior to the execution of any work. The Works Programme shall take full account of the Design Submission Programme.

2.4.2 **Content**

1) The Works Programme shall demonstrate by reference to its Sub-Programmes, Supplementary Programmes and associated Management Plans, the sequence and duration of activities and any restraints thereto, that the Contractor shall adopt to achieve Key Dates and to fulfil all Contract obligations. The Works Programme shall become the Engineer's basis of administration of the time-related aspects of the Contract.

2) 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 in order that the CPM networks developed can be freely analysed.

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

   i) all work comprising the Permanent Works;

ii) preparation, submission and review of Design Documents showing all items where review by the Engineer is required;

iii) preparation and submission for review of mock-ups and prototypes;

iv) 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;

v) any software development requirements and Validation time frames;

vi) all manufacture or prefabrication of materials or components;

vii) all design and installation of major Temporary Works;

viii) all activities associated with the securing of necessary permits and other statutory approvals for the Works;

ix) access and availability dates for all Project Contractors;

x) all interfaces related to the Project that may affect the progress of the Works;

xi) testing and commissioning activities which demonstrate an understanding of the interfaces and requirements of Chapter 9 below; and

xii) Training.

4) The Works Programme shall be divided into Sub-Programmes of manageable sizes addressing in more specific detail, the content of the Management Plans as stated in Chapter 3 below. The Sub-Programmes shall be as follows:

i) Design Submission Programme;

ii) Design, Procurement and Manufacturing Programme;

iii) Installation Programme; and

iv) Testing and Commissioning Programme.

v) Training Programme

5) The submission of the Works Programme shall include the Design, Procurement and Manufacturing Programme and a preliminary version of the Installation programme and the Testing and Commissioning Programme identifying all major installations, testing activities and associated interfaces.

6) The Sub-Programmes shall be further substantiated by the following supplementary programmes

i) Time Chainage Programme (T/C); and

ii) Other programmes required by the Employer's Engineer.

7) The Contractor's Works Programme shall comply with the following:

i) all programmes, except the Time Chainage Programme, shall be computerised Critical Path Method (CPM) networks developed using the Precedence Diagramming Method (PDM), and submitted in both hard copy and electronic data format;

ii) all programmes, except the Time Chainage Programme, shall be prepared using the latest version of CPM scheduling software Primavera Project Planner;

iii) unless consent is otherwise obtained from the Engineer, all programmes shall be accompanied by a Programme Analysis Report as described in clause 2.20 below;

iv) 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 non-work periods. If a Key Date or Milestone falls on a Public Holiday or non-work day, it shall be effective the next working day;

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

vi) CPM programmes shall reflect status using remaining duration and percent complete;

vii) 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:

i) major manpower for both design and installation;

ii) number of items of Contractor's Equipment;

iii) number of drawings and other design deliverables;

iv) principle quantities of components or parts;

v) principle quantities of bulk materials inclusive of cabling, pipe, ductwork and equipment items, etc.

2.4.3 All programmes constituting the Works Programme shall be organised in a logical work breakdown structure including work stages or phases. Each activity shall be coded to indicate, as a minimum, the work group or entity responsible for the activity, the area, facility or location and the Cost Centre in which the activity is included, from information provided in the Pricing Document. Key Dates and Milestones shall be coded so as to be separately identifiable. The Contractor may be required to assign additional activity codes as required by the Engineer.

2.5 Design Submission Programme

2.5.1 The Contractor shall, within 28 days of the Commencement Date of the Works, submit a Design Submission Programme covering all proposed submissions to the Engineer. The Design Submission Programme shall be broken down into a submission programme for each of the Management Plans each of which shall define the dates for individual submissions and these shall conform to the baseline dates shown in the Works Programme.

2.5.2 The Submissions Programme shall include the requirements of the Design Submissions as described in clause 3.5.1 below, including the procurement activities of all sub-contractors and suppliers.

2.5.3 The Submissions Programme shall include each submission for every item listed in the Specification as being required to be submitted.

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

1) progress of design, manufacture, installation and testing work;

2) co-ordination with other Contractors; and

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

2.5.5 The Design Submission Programme shall specifically include a milestone for the submission by the Contractor of the Final Design on completion of the Preliminary Design stage referred to in clause 3.5.1(1) below. The Final Design shall include at least but not limited to; details showing all of the proposed equipment, interconnections, physical layout, installation locations and interfaces to other suppliers.

2.6 Design, Procurement and Manufacturing Programme

2.6.1 Within 56 days of the Commencement Date of the Works, the Contractor shall submit for review by the Engineer a Design, Procurement and Manufacturing Programme that shall be an integrated part of the overall Works Programme.

2.6.2 The Design, Procurement and Manufacturing Programme shall show the interdependencies between engineering disciplines as well as between the Contractor and its sub-contractors and suppliers. This programme shall demonstrate compliance with the requirements of the Submissions Programme in clause 2.5 above.

2.6.3 The Contractor shall submit a weighted bar chart of the Contractor's design, procurement and manufacturing activities. Each activity weight shall normally not be more than 5% of the total man-hour content or value of the respective work.

2.6.4 The Design, Procurement and Manufacturing Programme shall include a separate breakdown, supported by the Material Control Schedule, which shall be a complete amplification of the Contractor's programme and equipment list, including those items which are subject to long lead time or component parts which are manufactured from countries outside the country of assembly and testing.

2.6.5 The Material Control Schedule shall be automated, and shall detail the following information for each permanent major and minor material and significant component. It shall be submitted as stated in the PS, or if none is given, within 56 days of the Commencement Date of the Works. The format of such a schedule shall include:

1) name, description, supplier/sub-supplier details;

2) drawing information (where appropriate), title, drawing status, submission dates, shop drawings/ fabrication drawing preparation, etc.;

3) the manufacturing process, manufacturing of test pieces, trial production, Engineer's inspection, monthly production of components and monthly supply of components;

4) the assembly process, erection and assembly sequences (particularly for the first pieces) prior to shipment, test assemblies, monthly assembly requirement, Engineer's inspection, testing of assemblies; and

5) transportation process, quality release from factory, factory storage, transport to dock, shipment.

2.6.6 The Contractor shall continuously maintain this schedule and report upon the status of each item as part of the Contractor's regular progress reporting.

2.6.7 From this base data, the Contractor shall prepare an exception report detailing all components that are in delay. This report shall be annotated with the reason for the delay and indicate what action the Contractor is taking to recover the lost time.

2.6.8 The Contractor shall submit, as part of the Design, Procurement and Manufacturing Programme, a Factory Testing Programme that shall support all aspects of the Factory Testing Plan. This Programme shall clearly demonstrate the logic and include the topics listed in clause 3.5.3 below.

2.6.9 The Factory Testing Programme shall be fully detailed, with activities individually identifying all tests for which a certificate will be issued, and shall include activities for preparation, submittal and review of the test procedures.

2.6.10 The Factory Testing Programme shall demonstrate the logical dependencies between the individual tests of the Works, and shall also show the interfaces and dependencies with the Contractor's delivery programme.

2.6.11 The Factory Testing Programme shall include details of inspection, testing and witnessing of the Contractor's and subcontractor's procurement and manufacturing activities. As a minimum, it shall include:

1) First Article Inspection;
2) Quality Hold Points;
3) Quality Control Points;
4) Type Tests; and
5) Routine tests.

2.7 Installation Programme

2.7.1 The Installation programme preliminary version shall be submitted within 56 days of the Commencement Date of the Works. The Final Installation Programme shall be submitted as stated in the PS or as directed by the Engineer. The Installation Programme shall comply with the requirements of clause 2.4.2(7) above.

2.7.2 The Installation Programme shall include detailed activities describing all aspects of the installation of the Works, to meet all Milestones and Key Dates given in the Contract. It shall be clearly linked to the Design, Procurement and Manufacturing Programme and Testing and Commissioning Programme to form an integrated part of the Works Programme.

2.7.3 The Installation Programme shall be fully supported by the Construction and Installation Management Plan as specified in clause 3.6 below.

2.7.4 The Installation Programme shall indicate the physical areas to which the Contractor requires access, access date, duration required and the required degree of completion for civil or architectural finishes prior to the access date.

2.7.5 The Installation Programme shall take into account the requirements for arrival at port, delivery, storage, preservation and positioning of large items of Contractor's Equipment and Permanent Works and shall set out the Contractor's proposed delivery route for such items to the Site.

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

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

2.7.8 In preparing the Installation Programme, the Contractor should note that the following conditions shall apply:

1) the Contractor shall not have exclusive access to any part of the Site except by the specific consent of the Engineer;

2) the Contractor shall take note that concurrent time allocations for certain areas may be given to more than one contractor. The Contractor shall co-ordinate the Contractor's work in such areas with that of Project Contractors through the Engineer;

3) the absence of a programme date or installation period for the Contractor in a specific area shall not prejudice the right of the Engineer to establish a reasonable programme date or installation period for that area;

4) the Contractor shall comply with the identified Key Dates. The Contractor shall also comply with the Milestone dates identified in the Schedule of Milestones; and

5) the Contractor shall deliver all Contractor's Equipment and Permanent Works for stations and ventilation shafts by road and via temporary access openings unless otherwise reviewed by the Engineer.

2.8 Testing and Commissioning Programme

2.8.1 The Preliminary version of Testing and Commissioning programme shall be submitted within 56 days of the Commencement Date of the Works. The final Testing and Commissioning Programme shall be submitted as stated in the PS or as directed by the Engineer and shall comply with the requirements of clause 2.4.2(7) above.

2.8.2 The Contractor shall submit the Testing and Commissioning Programme that shall fulfil all the on-Site testing and commissioning requirements of clause 9.3.2(2) below. The Testing and Commissioning Programme shall clearly demonstrate the logic and highlight the topics listed in the On-Site Testing and Commissioning Plan in clause 9.3.2(2) below.

2.8.3 The Testing and Commissioning Programme shall be fully detailed, with activities individually identifying all tests for which a certificate will be issued, and shall include activities for preparation, submittal and review of the test procedures.

2.8.4 The Testing and Commissioning Programme shall demonstrate the logical dependencies between the individual tests of the Works, and shall also show the interfaces and dependencies with all of the Project Contractors' tests required to commission the Works and support the Commissioning Plan.

2.9 Training Programme

2.9.1 The Contractor shall, within 175 days of the Commencement Date of the Works, or as stated in the PS or directed by the Engineer, submit for review by the Engineer, a Training Programme covering all proposed formal Training Programme courses, delivery of training equipment and accesses by the Employer's personnel for informal 'hands on' technology transfer. The Training Programme shall also detail specific Transfer of Technology features as required by the Specification and proposed by the Contractor.

2.9.2 The Training Programme shall be developed to the Training and Transfer of Technology Plan as required under clause 3.7.4 below.

2.9.3 The Training Programme shall be sufficiently detailed that the Employer can ensure the availability of staff for all the courses required under clause 10.1.6 below.

2.9.4 The Training Programme shall include the requirements of Chapter 10 below, including the Training activities of all sub-contractors and suppliers.

2.10 Not Used

2.11 Not Used

2.12 Time Chainage Programme (T/C)

2.12.1 For installation to be carried out in sections of the railway (whether in tunnels, in car depot or in RSS/TSS areas), the Contractor shall submit a T/C Programme 56 days before the start of Site works. The format and content of the T/C Programme shall be submitted for review by the Engineer prior to submission of the substantive T/C programme itself.

2.12.2 The T/C Programme shall be compatible in all respects with the Works Programme and shall include, but not be limited to, details of the planning of the Works in a linear time/location manner. The T/C Programme shall demonstrate how linear tasks interrelate with time, access points, access/handover dates, planned production outputs, construction material call-off rates, etc.

2.12.3 The T/C Programme shall be updated and submitted to the Engineer on a minimum three (3) month basis or when installation methods, production rates or interfaces deviate from that shown in the Works Programme.

2.13 Track Related Installation Programme (TRIP)

2.13.1 The Employer and the Employer's Engineer shall, upon taking over the Permanent Works for works train running, maintain a co-ordination between the various contractors wishing to work in the train tunnels.

2.13.2 The Contractor and each other contractor will submit his requirements in a form similar to that required in the T/C in clause 2.12 above. The Site Co-ordination Team referred to in clause 9.5 below will maintain the TRIP and resolve conflicts between contractors by discussion at the weekly Works Train meeting to which the Contractor may send a representative.

2.13.3 The TRIP and associated safe working documentation issued by the Site Co-ordination Team shall be accepted by all contractors as limiting their areas of working. Any work carried out in contradiction to that allowed by the TRIP will be considered to be a breach of the site safety arrangements.

2.14 Not Used

2.15 Programme Submissions

The Contractor shall submit all programmes described in this Chapter in conjunction with the Management Plans described in Chapter 3 below to the Engineer for review.

2.16 Programme Review

2.16.1 The Engineer shall, within 28 days of receipt of the submission of any programme for review, either give a notice of no objection or provide specific details as to why a notice of no objection is not given. If the Contractor is advised that the programme is not given a notice of no objection, the Contractor shall amend the programme taking into account the Engineer's comments and/or requirements and resubmit the programme within 14 days.

2.16.2 In the case of further re-submittals, the resubmission time shall also be 14 days.

2.17 Works Programme Revisions

2.17.1 The Contractor shall immediately notify the Engineer in writing of the need for any change in the Works Programme, whether due to a change of intention or circumstances or for any other reason. Where such a proposed change affects the timely completion of the Works or any Section or Stage; the Contractor shall within 14 days of the date of notifying the Engineer submit for the Engineer's review his proposed revised Works Programme and accompanying Programme Analysis Report. The proposed revised Works Programme shall show the sequence of operations of any and all work related to the change and the impact of changed work or changed conditions on the Works and Project Contractors and their works.

2.17.2 If at any time the Engineer considers the actual or anticipated progress of the work reflects a significant deviation from the Works Programme, he may request the Contractor to submit a proposed revised Works Programme. Upon receipt of such a request the Contractor shall submit within 14 days a revised Works Programme, together with an accompanying Programme Analysis Report and Narrative Statement, that shall demonstrate the means by which the Contractor intends to eliminate the deviation.

2.18 Monthly Progress Report

2.18.1 The Contractor shall prepare Monthly Progress Reports covering all aspects of the execution of the Works. Such Monthly Progress Reports shall be in writing and shall be submitted to the Engineer within 7 days after the last day of the period to which it relates. The Monthly Progress Report shall take account of work performed up to and including the last day of the month to which the Monthly Progress Report relates. The first report shall cover the period up to the end of the first calendar month following the Commencement Date.

2.18.2 The Monthly Progress Report shall include an executive summary and contain clear and concise statements in respect of every significant aspect of the Works including, without limitation, the requirements specified in APPENDIX 1 of this Specification.

2.18.3 The Monthly Progress Report shall contain evidence that documents and supports the progress of the Works, as stated in the Interim Payment Certificates, to the satisfaction of the Engineer.

2.18.4 The reports, documents and data provided shall be an accurate representation of the current status of the Works and of the work to be accomplished and shall provide the Engineer with a sound basis for identifying problems and deviations from planned work and for making decisions.

2.19 Programme Analysis Report

2.19.1 The Contractor shall submit a Programme Analysis Report that shall, in narrative format, describe the basis and assumptions used to develop all programme submissions. The Programme Analysis Report shall be prepared in a format having been reviewed without objection by the Engineer and contain as a minimum the following:

1) cycle times and work sequences;
2) the deployment of Contractor's Equipment and labour;
3) the production rates used in determining duration;
4) the shifts assumed in determining duration;
5) the breakdown of labour requirements by trades;

6) the schedules of quantities used in developing the programme, to the extent that such information is not provided elsewhere;

7) interfaces with the Engineer and Project Contractors and other constraints; and

8) any assumptions used in the programme.

2.19.2 The Programme Analysis Report shall be in sufficient detail to enable the duration, leads and lags in the logic diagram to be reconciled and substantiated, and to enable the projected levels of labour (by trade) and staff and flows of goods, materials and equipment to be substantiated.

2.20 Key Date and Milestone Report

2.20.1 The Key Date and Milestone Report shall be prepared in a format reviewed by the Engineer and identify and state the status of: -

1) all Key Dates and Milestones that were planned to be achieved in the reporting period or earlier but have not been achieved;

2) all Key Dates and Milestones that have been achieved in the reporting period;

3) all Key Dates and Milestones that are planned to be achieved in the next reporting period; and

4) any future Key Dates and Milestones that appear unlikely to be achieved on time.

2.20.2 The Key Date and Milestone Report shall identify, for all relevant Key Dates and Milestones, the planned dates, the actual dates achieved, and where the original planned dates are forecast to be unachieved, the revised dates identified in the Contract, as the same may be revised from time to time in accordance with the Contract.

2.20.3 The Key Date and Milestone Report shall also provide an explanation for any deviation from the planned dates. Measures taken or required to recover programme delays shall also be identified.

2.21 Physical Progress (Earned Value) Report

2.21.1 General

The Contractor shall prepare and submit monthly, a Physical Progress Report based on earned value techniques in accordance with the procedure described below. The proposal for the Physical Progress Report and basis for measuring progress shall be prepared in accordance with the requirements listed below and shall be submitted within 28 days of the Commencement Date of the Works.

2.21.2 Selection of work activities

1) Earned value progress reporting requires that the Contractor's work activities be broken down into discrete measurable units that are time phased (0% to 100% complete) in accordance with the Contractor's programme and maximum limit. These discrete measurable units shall be based on the physical deliverables and are weighted by the value of the items in Indian Rs in order to summarise the activities into a planned percent complete curve. The format for presenting the earned value progress measurement information in a Physical Progress Report is to be reviewed by the Employer's Engineer.

2) Key work activities for reporting progress shall be determined by the Employer's Engineer in consultation with the Contractor.

3) To the maximum extent possible, activities shall be chosen which can be measured quantitatively rather than subjectively as the work progresses. In the event it is necessary to use activities that can only be measured subjectively, intermediate activities or milestones shall be identified on the programme which will establish a predetermined intermediate percent complete for the activity at attainment of each intermediate milestone. Such milestones shall be no more than one month apart.

2.21.3 **Activity weighting**

In order to summarise the key individual activities into an overall planned or actual percent complete, activities must be weighted. Various methods for determining the appropriate weighting can be used. The Contractor may propose an existing methodology comparable to the intent of the earned value concept. The Employer's Engineer will assess and, if appropriate, review the method proposed by the Contractor. The sum of the weighting for all activities shall equal one hundred percent (100%).

2.21.4 **Revisions to Physical Progress Report**

Once the weightings have been established, they shall not be changed unless there is a variation that significantly impacts on the programme and the weightings. If, after review, it is decided by the Employer's Engineer to incorporate a major variation, the weightings shall be adjusted for the impact of the variation and both the plan and actual curves revised. The curves shall be recalculated by inserting the variation activity percent complete plan (0 to 100%) in the time frame it will occur and applying the revised weightings. This recalculation shall be submitted to the Employer's Engineer for consideration and review prior to its use in the Monthly Progress Reports. The other time-phased planned activities shall remain unchanged during this process in order to maintain the integrity of the baseline plan.

2.21.5 **Measurement of activity progress**

1) The actual percentage of the Works completed shall be calculated on a monthly basis as required to support the preparation of the Physical Progress Report and the Project status reviews. The Contractor shall ensure that sufficient reliable quantitative backup documentation exists to support these calculations for each activity within the Physical Progress Report.

2) Periodic detailed reviews may be made by the Employer's Engineer to assess the Contractor's calculations.

2.22 Progress Meetings

2.22.1 The Employer will chair progress meetings every month with the Contractor. These meetings will be held at dates and times to be advised by the Engineer. Progress meetings shall not be later than 7 days after the issue of the Contractor's Monthly Progress Report.

2.22.2 The Engineer may convene at his discretion, at any time upon reasonable notice to the Contractor, any meeting, either on or off the Site, to discuss and address any aspect of the Works or the Contract. The Contractor shall attend any such meetings convened by the Engineer.

2.22.3 All meetings shall be convened in New Delhi unless directed otherwise by the Engineer. Meetings shall be attended by senior personnel from the Contractor who shall arrive properly briefed for all aspects of the meeting and shall be empowered to make executive decisions in respect of the execution of the Works.

2.23 Quarterly Review Meetings

2.23.1 The Engineer may convene Quarterly Review Meetings in New Delhi at approximately three-monthly intervals. The Engineer will notify the Contractor the date of such Quarterly Review Meetings not less than 28 days before they are to be held.

2.23.2 Quarterly Review Meetings shall be held in order to review the overall progress of the Works in the context of the Project as a whole and to address and resolve any issues relevant to the execution and progress of the Works. Such Quarterly Review Meetings will be chaired by the Senior Director, Capital Projects of the Employer or his delegate. The Contractor shall have in attendance one senior representative of Director level from each of the companies comprising the Contractor (together with the Managing Director of the company acting as leader or sponsor of the Contractor if it is a joint venture, consortium or partnership whenever necessary and required by the Engineer).

2.23.3 The Contractor shall submit names of the persons whom the Contractor proposes to attend each Quarterly Review Meeting to the Engineer for review not less than 7 days prior to each Quarterly Review Meeting.

* End of Chapter *

CHAPTER 3

3. MANAGEMENT PLANS AND SUBMISSIONS

3.1 General

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

3.1.2 The management plans are a family of "Stand-alone" plans and documents which shall be co-ordinated with each other and shall collectively define, describe and encompass the Contractor's proposed methods, procedures, processes, organisation, sequencing of activities to meet the requirements of the Particular Specifications in respect of the subjects listed.

Unless otherwise stated in the PS, all plans and documents shall be submitted in preliminary form within 56 days of the Commencement Date of the Works followed by detailed plans within 56 days of the preliminary submission.

3.1.3 Submissions of Plans shall be made:

1) when required in accordance with the Works Programme;
2) whenever the development of the Contractor's designs or planning allows the plan to be developed further;
3) in response to comments made by the Engineer in accordance with clause 4.3.6 below;
4) whenever any change occurs that invalidates the information contained in the previously submitted and reviewed document, within 14 days of the occurrence of such change; and
5) when requested by the Engineer from time to time.

3.2 General Organisation

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

1) Project Management Plan

a) Contractor's Project Plan

b) Interface Management Plan

2) Systems Assurance Plans

a) Quality Plans

b) Safety Plans

c) Electromagnetic Compatibility Management Plan

d) Software Quality Assurance Plan

3) Design, Procurement and Manufacturing Plan

a) Design Plan

b) Design Verification and Validation Plan

c) Factory Testing Plan

d) Procurement, Manufacturing and Delivery Plan

4) Construction and Installation Management Plan

a) Construction and Installation Plan

b) Health and Safety Documentation

c) Environmental Qualities Management Plan

d) Environmental Mitigation Implementation Schedule

e) Traffic Management Submissions (if required)

5) Completion Management Plan

a) Commissioning Plan

b) Operation and Maintenance Manuals Plan

c) Training Plan

d) Spares Management Plan

e) Defects Liability Management Plan

f) Supervision of Maintenance Plan

g) AMC Management Plan (if applicable)

3.3 Project Management Plan

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

3.3.1 Contractor's Project Plan

1) The Contractor's Project Plan shall provide a clear overview of the Contractor's organisation, management systems and methods to be used for the complete execution of the Works. The organisation resources for the design, procurement, manufacture, installation, testing and commissioning, and setting to work, shall be clearly defined.

2) The Contractor's Project Plan shall include a summary description of each and every stage of implementation of the Works, clearly showing the principal organisational interfaces both within the Contractor's own organisation (including sub-contractors of every tier) and with Other Contractors and Relevant Authorities, defining how each of these interfaces is to be managed and controlled.

3) The Contractor's Project Plan shall contain structured organisation charts showing the hierarchical relationship of the Contractor's organisation (including sub-contractors of every tier). The organisation charts shall be produced as a "family" such that the basic chart shows the overall organisation structure supported by subsidiary charts detailing the internal structure of the various departments or sections of the overall organisation. The Organisational Chart shall illustrate the subdivision of the work into elements for effective technical and managerial control, the reporting structure and the interface relationship among all parties involved. Names, addresses, telephone and fax numbers of all principal contacts shall be listed.

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

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

i) the procedure for audit;

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

iii) the procedures for filing system to be implemented to maintain the Contractor's records during the course of the work. The filing systems used by the Contractor and sub-contractors of any tier shall be compatible as far as is necessary;

iv) the procedures for the identification, production, verification, internal approval, review (when required) by the Engineer, distribution, implementation and recording of changes to all drawings, reports and specifications;

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

vi) the procedure for the regular review and revision of each type of quality plan and its supplemental individual specific quality plans to ensure their continuing suitability and effectiveness, in addition to the method to be used for revision and issue of revised documentation;

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

viii) the procedures for the selection, indexing, disposition and maintenance of project records for storage in the archives. A list of items to be archived including their periods of retention shall be submitted for review by the Engineer;

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

x) the procedures for the control of non-conformity.

6) Particulars of Contractor's Representative

i) The Contractor shall give and provide all necessary supervision during the execution of the Works as long as the Engineer considers necessary for the proper fulfilment of the Contractor's obligations under the Contract.

ii) The Contractor shall ensure that he is at all times represented on the Site by a competent and authorised English speaking Contractor's Representative who shall be deemed to have been reviewed without objection by the Engineer provided the

Contractor's Representative is not expressly objected to by the Engineer in writing within 14 days from the service of a notice upon the Engineer by the Contractor of the appointment of such Contractor's Representative. The Contractor's Representative shall be constantly on the Site and shall give his full time to the superintendence of the Works.

iii) The Engineer shall have the authority to withdraw his notice of no objection to the Contractor's Representative at any time. If such notice of no objection is withdrawn the Contractor shall remove the Contractor's Representative from the Site forthwith and shall not thereafter employ him again on the Site in any capacity and shall forthwith replace him by another competent English speaking Contractor's Representative reviewed without objection by the Engineer.

iv) The Contractor's Representative shall receive on behalf of the Contractor directions and instructions from the Engineer.

v) The following particulars of the proposed Contractor's Representative shall be submitted to the Engineer for review: -

a) name;

b) copy of Identity Card;

c) details of qualifications, including copies of certificates; and

d) details of previous experience.

vi) The particulars of the Contractor's Representative shall be submitted 28 days before the agreed scheduled start of that part of the Works. Except in the case of a replacement Contractor's Representative (as provided for in clause 3.3.1(6)(iii) above), in which case the said particulars shall be submitted forthwith.

vii) The Contractor's Representative shall possess relevant academic or professional qualification and have at least 10 years' experience in relevant engineering works. The Engineer reserves the right to call upon the Contractor to prove such qualifications/experience to the satisfaction of the Engineer.

7) The Contractor's Project plan shall be submitted as stated in the PS, or none is given, with 56 days of the Commencement Date of the Works.

3.3.2 Interface Management Plan

1) The Contractor shall interface and lease with other Contractors in accordance with the requirements of clause 16.3 below.

2) After notification from the Engineer of the identity of every Other Contractor, the Contractor shall develop and submit to the Engineer an Interface Management Plan within 56 days. The plan shall be mutually acceptable to both the Contractor and the other Contractors. The Interface Management Plan shall:

i) identify the sub-systems as well as the civil works and facilities with interfacing requirements;

ii) define the authority and responsibility of the Contractor's and other Contractors' (and any relevant sub-contractors') staff involved in interface management and development;

iii) identify the information to be exchanged, together with the management and technical skills required for the associated development work, at each phase of the Contractor's and other Contractors' (and any relevant sub-contractors') project life-cycles;

iv) include considerations of the Interface Hazard Analysis;

a) specify the configuration and version control procedures in accordance with the Contractor's and other Contractors' (and any relevant sub-contractors') quality management system; and

b) address the design, supply, installation, testing and commissioning programme of the contracts to meet the key dates of each contract, and highlight any programme risks requiring management attention.

c) The Contractor shall advise the Engineer immediately of any difficulty in developing a mutually acceptable Interface Management Plan.

d) Once the Interface Management Plan has been reviewed without objection by the Engineer, the Contractor shall execute the Works in accordance with the Interface Management Plan. Engineer

e) Within 84 days of notification from the Engineer of the identity of every Other Contractor, the Contractor shall develop and submit to the Engineer for review a Detailed Interface Document for every Other Contractor that is mutually acceptable to both contractors. The Detailed Interface Document shall address in detail how the dates identified in the Interface Management Plan shall be achieved and shall identify the data required by the interfacing other Contractors to meet the requirements of the PS.

f) The Detailed Interface Document shall specify the proposed method and schedule for verifying the interface integrity, the individual equipment/system performance and the combined system performance. The Detailed Interface Document shall include a programme of tests to demonstrate the performance and integrity of the integrated systems. The Interface Specification appended to the PS shall form the basis of the Detailed Interface Document, but does not relieve the Contractor's obligation to identify any new interface to meet the Contract requirements. Any revision to the Detailed Interface Document shall be mutually acceptable by contractors and submitted to the Engineer for review.

3.4 Systems Assurance Plans

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

3.4.2 The various plans shall be co-ordinated with each other and shall collectively define, describe and encompass the Contractor's proposed methods, procedures, processes, organisation, sequencing of activities, etc. and shall show how these combine together to assure that the Works truly meet the requirements of the Specification in respect of the subjects listed.

3.4.3 Configuration management of all hardware and software shall be in accordance with ISO 10007.

3.4.4 **Quality Plans**

The Contractor shall submit for review by the Engineer quality plans in accordance with the requirements of clause 5.2 below .

3.4.5 **Safety Plans**

1) **Site Safety Plan**

i) The Contractor shall prepare a Site Safety Plan incorporating the requirements of the Safety, Health and Environment Management Manual and designed specifically for the various sites (including storage and overseas sites) on which work under the Contract is to be carried out.

ii) The Site Safety Plan shall form a part of the Safety, Health and Environment Management Manual referred to in Chapter 18 below .

2) **RAMS Plan**

i) The Contractor shall implement a formal Reliability Plan and a formal Maintainability Plan in accordance with the PS. and EN 50126 (Railway applications - The specification and demonstration of reliability, availability, maintainability and safety (RAMS)).

ii) The Contractor's Reliability Plan and Maintainability Plan shall include Failure Modes, Effects and Criticality Analysis and the production of a Reliability Critical Items List.

a) The Contractor shall submit for review by the Engineer the Contractor's Systems Safety Plan. The plan shall at least include Hazard Analysis plan, Fire Control Plan, EMC/EMI Control Plan. The System Safety plan shall address all the factors referenced in APPENDIX 2 of this Specification and as required by the PS.

b) The Contractor shall submit for review by the Engineer the Contractor's Reliability Plan and Maintainability Plan in accordance with the requirements of clause 1.10 above.

3.4.6 **Electromagnetic Compatibility Management Plan**

1) The Contractor shall prepare and submit for review by the Engineer an EMC Management Plan which shall, based upon a top-down approach, define the EMC philosophy, activities, means of control for the design processes and EMC submissions to be supplied to demonstrate compliance with the PS and GS. The plan shall be submitted as stated in the PS, or none is given, with 56 days of the Commencement Date of the Works.

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

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

4) The EMC Management Plan shall include a definition and description of the process and methods used for Verification and Validation that the Works will achieve the required EMC parameters in all respects.

5) The Contractor shall liaise and co-ordinate the levels of interference emissions and susceptibility of all equipment which are to be designed, manufactured, supplied and installed by the Contractor and its sub-contractors and suppliers. The Contractor shall designate a person as point of contact to deal with EMC matters. Details of the nominated person and any subsequent change of the nominated person shall be subject to review by the Engineer.

6) The Contractor shall liaise and co-ordinate with all Other Contractors in the exchange of EMC data and related equipment performance characteristics and advises the Engineer when any such information is requested from any Other Contractor. A copy of all EMC related information exchange shall be sent to the Engineer for review.

7) The Contractor shall comply with the following EMC requirements:

(i) The Contractor shall ensure that all electrical and electronic apparatus is designed and constructed to operate without degradation of quality, performance or loss of function in the electromagnetic environment of the Project.

(ii) The Contractor shall meet the requirements of the BS EN50121 series of standards (Railway applications – Electromagnetic compatibility), 1996 edition, the UK's Electromagnetic Compatibility Regulation, the IEC 61000: Electromagnetic Compatibility or equivalent and other standards mentioned in the PS to be reviewed by the Employer's Engineer. EMC considerations shall be incorporated in the Contractor's procedures for product safety and design Verification.

(iii) Detailed requirements in respect of electromagnetic compatibility characteristics are contained in the PS.

(iv) The design shall ensure that any electromagnetic interference emissions introduced into the environment do not exceed those detailed in the PS and GS. The Contractor shall ensure that the specified electromagnetic compatibility (EMC) requirements are adequate. Any shortcomings shall be made known to the Engineer immediately and recommendations for corrective action formulated.

(v) In respect of the design documentation, the Contractor shall demonstrate by theoretical analysis that the design of the electrical and electronic systems is fully compliant with the EMC requirements identified. The Contractor shall state clearly in the documentation all the assumptions made and parameters used in the analysis.

(vi) The Contractor shall detail the methodology, verify and validate any simulation models used in support of the analysis. The Contractor shall prepare and submit to the Engineer for review reports of the Verification and Validation of the models.

(vii) In the circuit analysis, calculations shall be made for all component tolerance effects due to manufacture, environment, ageing, and all possible component Failure Modes. If any component can exist in a Dormant Failure Mode, the analysis must assume that the component has failed. The Contractor shall identify all component Failure Modes considered and produce evidence to the Engineer for review.

(viii) The Contractor shall identify all components to be tested, specify the interval between routine tests, define the test procedure and provide Verification levels and pass marks, which must be achieved. The Contractor shall carry out proof testing of circuit components.

(ix) The Contractor shall supply documentation showing how system safety and reliability is ensured. It shall include Failure Modes, system failures, the effect of human intervention and how equipment thresholds have been set in order to keep them above worst-case interference levels, and how equipment tolerances and other characteristics in the Specification have been allowed for in designing the system.

(x) The Engineer may conduct an independent EMC audit for both the system and its component parts and shall therefore require access to all the relevant design and production information. The Contractor shall supply sufficient documentation and analysis in a form reviewed by the Engineer.

(xi) EMC type testing shall be carried out on all equipment identified in the design stage which require attention regarding EMC.

(xii) The Engineer may request at his discretion, attendance at the manufacturing factory prior to delivery to assist in providing confidence that the EMC requirements will be met. However, this will not give design acceptance that can only be given after successful completion of the System Acceptance Tests.

(xiii) The Engineer may request that tests be carried out to simulate the Failure Mode of any critical hardware/software component that is considered to have a significantly detrimental effect.

(xiv) 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.

(xv) 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 Liability Period shall not cause the immunity or emission levels of the installed system and equipment to exceed such values. Detailed EMC documentation on all modifications carried out shall be submitted to the Engineer for review. Modification work shall not commence until the respective submission has been reviewed without objection by the Engineer.

3.4.7 Software Quality Assurance Plan

Where software is a design deliverable, the Contractor shall submit a Software Quality Assurance Plan in accordance with the requirements of clause 6.1 below as stated in the PS, or none is given, with 56 days of the Commencement Date of the Works. The Software Quality Assurance Plan shall address all elements of the design and development of software required as part of the Works.

3.5 Design, Procurement and Manufacturing Plan

3.5.1 Design Plan

1) Design shall be undertaken to ensure a smooth flow of information for review by the Engineer. Submissions shall be strictly in accordance with the Design Submissions Programme prepared in accordance with clause 2.5 above.

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

i) Conceptual Design Stage

Design of the overall system and elaborating on the proposed system configuration with emphasis on how the interface requirements are to be achieved.

a) The Contractor shall prepare and submit to the Engineer for his review a System Requirement Specification (SRS) which includes, as a minimum, operational, functional, performance and design requirements of the proposed system.

b) The System Requirement Specification, serving as a means of system requirement management and the Contractor's top-level design document, shall state all the requirements completely and unambiguously and how each requirement can be verified and validated.

c) The System Requirement Specification shall include a compliance matrix that includes cross-references to the requirements stated in the PS, the System Requirement Specification and the Design Verification Table (DVT).

d) The conceptual design stage, as a minimum, shall identify the function of each system, sub-system, equipment or other element within the overall SRS and specify the relationships and interfaces between each element of the system, including the systems of the interfacing elements of other Contractors.

ii) Design Review

a) A series of Baseline Design Reviews shall be arranged prior to the conclusion of the Conceptual Design Stage. Within 28 days after completion of each critical design submission during preliminary design, the Contractor shall arrange a Design Baseline Review meeting to baseline the design for the next stage of activity.

b) Upon completion of the Conceptual Design Stage the Contractor shall submit for review by the Engineer a homogenous Preliminary System Design.

iii) Preliminary Design Stage

The preliminary design stage shall address each element of the SRS as developed in the Preliminary Design. Equipment and interconnection specifications, with supporting calculation, shall be developed at this stage. Manufacturing of production units will only be allowed to commence after receiving a notice of no objection for the relevant design elements.

a) Preliminary electrical and control schematics shall be developed to illustrate how the various operational and functional requirements can be achieved. Software design and development shall also be carried out during this stage.

b) The submission shall clarify and confirm as necessary all technical aspects of all interfaces with other elements of the Contractor's overall design and of any interfaces with works being supplied by other Contractors.

c) Ergonomic design, followed by the production of mock-ups and prototypes shall be developed as part of the preliminary design.

d) If at any time in the development of the preliminary design, the Contractor wishes to modify the conceptual design by dividing any system or sub-system into a number of smaller systems or by reconfiguring the interfaces or for any other reason, the Contractor shall resubmit the SRS and/or the Preliminary Design for the Engineer's review.

e) A detailed submission list for the preliminary design shall be submitted to the Engineer for review 28 days prior to the start of the preliminary design. The submission shall be in sufficient detail to evaluate the progress and technical adequacy of the selected design approach.

f) Upon completion of the Preliminary Design Stage the Contractor shall submit for review by the Engineer a homogenous Final Design.

iv) Site Design Stage

Installation detail and method statements for various areas and sections shall be released progressively during this stage. Installation works on Site will only be allowed to commence following the Engineer's review of the relevant design information with no objection raised.

3) Separate parts of the design plan shall be prepared for Contractor and subcontractor design activities. The design plans shall define the Contractor's policy for the design of the Works and shall, without limitation, define:

i) the organisation of the Contractor's design staffs with particular reference to the design interfaces;

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

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

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

a) 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;

b) the design methods. Software applications to be used in the design, both proprietary and public domain, including any requirements for physical and mathematical model testing;

c) the preparation, checking, issue, distribution, indexing and filing of reports, calculations, drawings and specifications together with the means for their revisions;

d) the formal design review, authorisation and approval of design documentation; and

e) the independent design Verification and Validation.

3.5.2 **Design Verification and Validation Plan**

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

   i) the objectives of each Verification phase and each Validation phase;

   ii) defined input and output criteria for each development phase;

   iii) identification of types and detailed methods of test, Verification and Validation activities to be carried out;

   iv) detailed planning of Verification and Validation activities to be carried out, including schedules, resources and approval authorities;

   v) selection and utilisation of the test equipment, and their test environmental conditions; and

   vi) criteria on which the Verification or Validation is judged to be acceptable. These criteria shall be traceable to the design and performance requirements as referred to in Clause 3.5.1(3)(iv)(a) above.

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

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

   The DVT shall identify the proposed Verification and Validation process(es) for each specification requirement and the acceptance criteria for achieving the requirement. The DVT does not relieve the Contractor of any other requirements of the Specifications in relation to design review, Verification, Validation, conformance or planning.

4) For each item in the DVT, the Verification and Validation methods to be used shall be listed by the Contractor. The methods used shall be reviewed by the Engineer. At least one stage of Verification and Validation shall be performed prior to production of an item.

5) Subject to review without objection by the Engineer for each application, the Verification and Validation methods listed below are acceptable if implemented (whether singly or in combination):

   i) Similarity - equipment and requirement are identical to those successfully applied on other projects.

   ii) Historical - requirement has been met by numerous previous designs.

   iii) Calculations and Drawings - for review.

   iv) Design Review - either scheduled or specifically targeted.

   v) Mock-Up - actual size representation of design.

vi) Development Test - performance testing on equipment or material under development.

vii) Type Test - performance testing of the as-built component, assembly or system.

viii) Routine Test - test every component, assembly or system.

ix) First Article Inspection (FAI) - acceptances of the exact look and fit of equipment.

x) Inspection - formal inspection of the finished item.

xi) In Service - for service demonstration requirements only.

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

1) the Verification or Validation results stating whether the objectives and criteria of the Design Verification and Validation Plan have been met; and

2) the reasons for failure if there is a failure, and proposal for remedial actions.

3.5.3 Factory Testing Plan

1) The Contractor shall prepare and submit for review by the Engineer the Contractor's Factory Testing Plan detailing and explaining how the Contractor will plan, perform, and document all inspections and tests that will be conducted to verify and validate the Works prior to delivery to the Site. The plan shall be submitted as stated in the PS, or if none is given, within 56 days of the Commencement Date of the Works. The plan shall consist of a narrative description supported by graphics, diagrams and tabulations as required.

The plan shall contain but not be limited to the following topics:

i) the Contractor's strategy for inspection and Factory Acceptance Tests of all constituent parts of the Works and how this relates to the sequence of delivery;

ii) the sequencing and interrelationships of the inspections and tests including:

a) all Quality Hold Points; and

b) all Quality Control Points;

iii) the type and extent of inspection and Factory Acceptance Tests to be undertaken and the parts of the Works to be proven by that testing;

iv) the objective of each inspection or test, what particular design and operating criteria the test or inspection will prove and how the success of the test or inspection will be demonstrated or measured;

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

vi) the plan for the production and submission of the inspection and test procedures to the Engineer for review including the submission of the inspection and test reports and records; and

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

2) The Contractor shall arrange for all equipment and systems manufactured for incorporation into the Permanent Works to undergo a Factory Acceptance Test (FAT) before shipment

from the place of manufacture. Any particular requirements for inspection and testing at the place of manufacture are prescribed in the PS.

3) The Contractor shall be responsible for re-inspecting and re-testing any failed inspection and Factory Acceptance Test including regression testing on previously passed items.

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

5) Type Tests as detailed in clause 9.2.6 below shall be performed on all items of equipment to be installed as part of the Permanent Works under the Contract. The Type testing shall be based on the environmental class of the sites into which the equipment will be installed. Refer to clause 1.12.3 above for the different environmental classifications or otherwise as required in the PS.

6) For all production items a First Article Inspection shall be undertaken as detailed in clause 9.2.7 below. Routine production testing methods shall be detailed for review by the Engineer. Routine testing shall ensure that all samples of a production item are within the tolerances required for complete interchangeability.

7) The Contractor shall prepare two copies of an inspection or test report immediately after the completion of each inspection or test whether or not witnessed by the Employer or the Engineer. If the Employer or the Engineer has witnessed the inspection or test, he will countersign the inspection or test report to indicate his review of the information and conclusions (i.e. whether or not the equipment being inspected or tested has passed satisfactorily) contained therein. If the Employer or the Engineer has not witnessed the inspection or test (i.e. if a waiver has been granted, or the Employer or the Engineer has not witnessed the inspection or test for some other reason in accordance with the Contract), the Contractor shall forward two copies of the inspection or test report without delay to the Engineer. The Engineer will countersign the report to indicate his review of the information and conclusions (i.e. whether or not the equipment being inspected or tested has passed satisfactorily) and return one copy to the Contractor. Where the results of the inspection or test do not meet the requirements of the Specification, the Employer or the Engineer may call for a re-inspection or re-test.

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

9) Test equipment and instrumentation shall be subject to approved calibration tests within a properly controlled calibration scheme, and signed calibration certificates shall be supplied to the Engineer in duplicate. Such calibration checks shall be undertaken prior to testing and, if required by the Engineer, shall be repeated afterwards.

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

3.5.4 Procurement, Manufacturing and Delivery Plan

1) The Contractor shall prepare procurement, manufacturing and delivery plans in respect of all items and goods. The plans shall be submitted as stated in the PS, or if none is given, within 56 days of the Commencement Date of the Works. Separate parts of the plan shall be prepared for Contractor or sub-contractor off-Site activities. Each plan shall identify the scope of work to be applied. In relation to such scope of work, it shall, without limitation, define:

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

ii) the specific allocations of responsibility and authority given to identified personnel for the day-to-day management of the work with particular reference to the supervision, inspection and testing of the work;

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

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

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

a) the purchasing of items and goods and ensuring they comply with the requirements of the Specification, including (without limit) purchasing documentation and specific Verification arrangements for Contractor/Engineer inspection of material or manufactured product prior to release for use;

b) the manufacturing process so as to ensure compliance with the design;

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

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

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

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

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

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

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

2) The Contractor shall prepare and submit the inspection and testing plans to manage and control any test and inspection activities in accordance with clause 3.5.3 above;

3) The Contractor shall propose a structured set of inspection hold points. The hold points shall be structured such that a formal hold point is allowed for each significant element of the manufacturing process. At each hold point, the Engineer shall hold a formal inspection or advise that the inspection has been waived.

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

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

3.6 Construction and Installation Management Plan

3.6.1 Construction and Installation Plan

1) The Contractor shall prepare plans for the construction and installation activities on and off the site, as referenced in clause 14.1.1 below, and shall ensure that these are properly related to the subsequent testing and commissioning activity.

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

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

i) the organisation of the Contractor's staff directly responsible for the day-to-day management of the activity on or off the Site;

ii) the specific allocations of responsibility and authority given to identified personnel for the day-to-day management of the Works with particular reference to the supervision, inspection and testing of the Works;

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

iv) the specific methods of construction and installation to identify any relevant method statements and develop those method statements to a sufficient degree of detail for review by the Engineer;

v) a detailed method statement which shall include but not be limited to:

a) description of main operations and sub-operations;

b) sequence of sub-operations;

c) quantities of the work and production rates to be achieved;

d) resources to be employed; and

e) quality checks to be carried out, supervision being exercised and safety precautions to be employed;

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

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

b) the purchasing of materials and ensuring they comply with the requirements of the Specification, including purchasing documentation and specific Verification

arrangements for Contractor/Engineer inspection of material or manufactured product prior to release for use/installation;

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

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

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

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

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

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

i) the handling, storage, packaging, preservation and delivery of product; and

vii) the security control of the Site and the works area for Contractor's accommodation, storage, car park and other works facilities, etc. in accordance with clause 15.10 below.

4) The Contractor shall prepare and submit the inspection and test plans to manage and control any test and inspection activities in accordance with clause 5.7.1 below.

5) Where all or part of the Works is within the DMRC Protection Zone, the Contractor shall follow the guidelines issued by the Employer's appropriate authority. The Contractor shall submit to the Engineer for review his construction method statement and detailed design of any Temporary Works proposed to be erected within this zone adjacent to DMRC properties.

6) The following particulars shall be submitted to the Engineer for review within 14 days of the Commencement Date of the Works:

i) drawings showing the layout within the Site of the Engineer's and Contractor's accommodation, Project signboards, access roads and major facilities required early in the Contract;

ii) drawings showing the layout and the construction details of the Engineer's accommodation; and

iii) drawings showing the details to be included on Project signboards.

7) Drawings showing the location of stores, storage areas, work areas and other major facilities shall be submitted to the Engineer for review as early as possible, but in any case, not later than 28 days before construction of the facilities.

3.6.2 Health and Safety Documentation

1) The Contractor shall submit Health and Safety Documentation to fully comply with the requirements of the Project conditions and proposed work activities in accordance with Chapter 18 below.

2) The Contractor shall submit to the Engineer the Health and Safety Documentation for review within 28 days of the Commencement Date of the Works.

3.6.3 Environmental Qualities Management Plan

The Contractor shall within 112 days of the Notice to Proceed submit an Environmental Plan based the Outline Environmental Plan submitted and adapted during the Tender period. The Environmental Plan shall contain sufficient information to demonstrate clearly the proposed method of achieving the Environmental objectives with particular reference to EMC/EMI etc. to meet the stipulations of Employer's Requirements -Particular Specification.

1) The Environmental Plan shall comprise a set of Environmental Plans as detailed below:
   - **Environmental Management Plan**;
   - **Environmental Mitigation Implementation Schedule** (if required); and
   - **Traffic Management submissions** (if applicable).

2) Environmental Plans shall include the Contractor's proposed means of complying with his obligations detailed in this GS and in the PS in regard to:
   a) The Site Environment as found; and
   b) System Environment as described in the Specification.

   The Environmental Plan shall include as required detailed policies, procedures and applicable regulations.

3) **Environmental Management Plan (EMP)**

   i) The Contractor shall submit for review by the Engineer, an Environmental Management Plan (EMP) which will set out in detail the approach for dealing with each of the potential environmental impacts arising from the various different construction activities.

   ii) The EMP shall address all the potential impacts outlined in the Employer's Final Assessment Report and shall follow the EMP Outline contained in this GS.

   iii) The Contractor shall submit the final EMP, for review by the Engineer, 28 days prior to the commencement of construction activities.

4) **Environmental Mitigation Implementation Schedule (EMIS)**

   i) The Contractor shall submit for review an Environmental Mitigation Implementation Schedule (EMIS) which is a plan for the provision of the mitigation measures identified in the EMP.

ii) The Contractor shall submit the EMIS, for review by the Engineer in conjunction with the EMP, 28 days prior to the commencement of construction activities.

5) **Traffic Management Submissions (if applicable)**

Where the Contractor is required to become involved with traffic or footpath management activities, submissions shall be made by the Contractor for the Engineer's review 56 days before implementation proving all relevant details and implications.

3.7 Completion Management Plan

3.7.1 The Contractor shall organise the services required under the Contract to bring the Works into service under one plan. This co-ordinated approach shall allow the Engineer the ability to review all aspects of the Works and services in an integrated manner.

3.7.2 Commissioning Plan

1) The Contractor shall ensure the timely preparation of the Commissioning Plan in a format and to a level of detail in accordance with clause 9.3 below. The Contractor shall submit the first draft of the Commissioning Plan to the Engineer within 175 days of the Commencement Date of the Works.

2) The Commissioning Plan shall consist of the following:

i) Factory Testing Plan (see clause 3.5.3 above)

ii) On-Site Testing and Commissioning Plan

a) **Installation Tests** Schedule

The Contractor shall submit to the Engineer a comprehensive schedule of Installation Tests as required by clause 9.4.3 below and the PS and in accordance with the Installation Programme as stated in clause 2.7 above. The schedule shall be submitted within the period of time laid down in the PS, or, if none is given, not later than two months in advance of the date for the commencement of the Installation Tests.

b) **Partial Acceptance Tests** Plan

The Contractor shall submit to the Engineer a comprehensive Partial Acceptance Tests Plan including all requirements detailed in clause 9.4.4 below and the PS. The plan shall be submitted within the period of time laid down in the PS, or, if none is given, not later than four months in advance of the date for the commencement of the Partial Acceptance Tests.

c) **System Acceptance Tests** Plan

The Contractor shall submit to the Engineer a comprehensive System Acceptance Tests Plan including all requirements detailed in clause 9.4.5 below and the PS. The plan shall be submitted within the period of time laid down in the PS, or, if none is given, not later than four months in advance of the date for the commencement of the System Acceptance Tests.

d) **Integration Testing & Commissioning** Plan

The Contractor shall submit to the Engineer a comprehensive Integrated Testing & Commissioning Plan including all requirements detailed in clause 9.4.6 below and the PS. The plan shall be submitted within the period of time laid down in the PS, or, if none is given, not later than four months in advance of the date for the commencement of the Integrated Testing & Commissioning.

3.7.3 **Operation and Maintenance Manuals Plan**

1) The Contractor shall develop an Operation and Maintenance Manuals Plan to suit staged commissioning of the system and to ensure the timely preparation of the Contractor's Operation and Maintenance Manuals and the 'As-Built' drawings in a format and to a level of detail reviewed without objection by the Engineer and in accordance with Chapter 11 below.

2) The Contractor shall submit the Operation and Maintenance Manuals Plan by the date stated in the PS, or, if none is given, not later than nine (9) months prior to the issue of the Taking Over Certificate for the Works and according to staged commissioning of the proposed systems.

3.7.4 **Training Plan**

1) The Contractor shall ensure the timely preparation of the Contractor's Training Plan in a format and to a level of detail reviewed without objection by the Engineer and fulfilling the requirements of clause 10.1 below.

2) The Contractor shall submit the Training Plan by the date stated in the PS, or, if none is given, not less than six (6) months prior to the issue of the Taking Over Certificate for the Works and also to suit the staged commissioning of the relevant systems.

3.7.5 **Spares Management Plan**

1) The Contractor shall submit for review by the Engineer a Spares Management Plan to furnish a priced, manufacturer-recommended list of spare parts necessary to support continuous operation of all such equipment for a minimum period of 24 months after the commencement of Revenue Operations, in accordance with Chapter 13 below.

2) The Contractor shall submit the Spares Management Plan by the date stated in the PS, or, if none is given, not less than six (6) months prior to the commencement of Revenue Operations

3.7.6 **Defects Liability Management Plan**

The Contractor shall submit for review by the Engineer a Defects Liability Management Plan to repair, replace and perform any remedial item upon the Works identified by the Engineer during the Defects Liability Period (DLP). The first submission of this plan is required six (6) months prior to the commencement of Revenue Operations. The Contractor shall:

1) endeavour to complete all necessary work in a timely responsible manner;

2) not proceed with any remedial work without the consent of the Engineer;

3) submit a plan that details the methods and timing of any proposed work; and

4) update the plan monthly, showing progress of the work and the time to completion.

3.7.7 **Supervision of Maintenance Plan**

The Contractor shall prepare outline plans for the management of the maintenance function in accordance with the requirements of clause 12.2.1 below and submit them for review by the Engineer at least 3 months prior to the scheduled commencement of **Service Trial**.

3.7.8 **AMC Management Plan (If applicable)**

The Contractor shall submit for review by the Employer's Representative an Annual Maintenance Contract Management Plan to repair, replace and perform any item upon the Works identified by the Employer's Representative during the Annual Maintenance Contract (AMC). The first submission of this plan is required six (6) months before the expiry of the DLP.

* End of Chapter *

CHAPTER 4

4. DOCUMENTS, SUBMISSIONS AND REVIEW

4.1 Documents, Submissions and Correspondence

Copies of correspondence relevant to the execution of the Works and not of a confidential nature received from or despatched to Government departments, utility undertakings and Project Contractors employed by the Employer shall be submitted to the Engineer for information as soon as possible but in any case, not later than 7 days after receipt.

4.2 Submissions to the Engineer

4.2.1 General requirements

1) All submissions shall be made to the Engineer in a format reviewed without objection by the Engineer and in accordance with the requirements in:

   i) the Contract;

   ii) the Computer Aided Design & Drafting (CADD) Manual; and

   iii) the Document Submittal Instructions to Consultants and Contractors.

2) Paper and drawing sizes shall be "A" series sheets as specified in BS 3429.

3) The following software (versions quoted or higher) 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
Text Documents	MS Word, Ver. 16
Spread Sheets	MS Excel, Ver. 16
Data Base Files	MS Access, Ver. 16
Presentation Files	MS PowerPoint, Ver. 16
Programmes	Primavera for Windows, Ver. 19.12
AutoCAD Graphics	CorelDraw, Ver. 22.0/ AutoCAD ver.24.0
Photographic	Adobe Photoshop, Ver.21.2.3
Desktop Publishing	QuarkXPress, Ver. 15.0
CADD Drawings	MicroStation CONNECT Edition (V10)
Portable Document Format files	Acrobat Reader Ver. 20

Media for Electronic File Submission

One copy shall be submitted unless otherwise stated. All text documents files shall also be submitted in pdf format also. The pdf file submitted shall be searchable and editable.

Internet File Formats/Standards

The following guidelines shall be followed when the Contractor uses the Internet browser as the communication media to share information with the Employer.

All the data formats or standards must be supported by Microsoft Internet Explorer version 11 or above running on Windows 10.

The following lists the file types and the corresponding data formats to be used on Internet. The Contractor shall comply with them unless the Engineer has previously reviewed without objection the Contractors proposal to adopt an alternative:

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)
Project documents	refer to the document type in clause 4.2.1(3) above.
Video	Window video (.avi)
Sound	Wave file (.wav)

The following states the standards to be used on Internet when connecting to database(s). The Contractor shall comply with them unless the Engineer has previously reviewed without objection the Contractors proposal to adopt an alternative: Function to be Implemented	Standard to be Complied With
Database connectivity	Open Database Connectivity (ODBC)
Publishing hypertext language on the World Wide Web	Hypertext Mark-up Language (HTML)

4) The hard copy of all documents shall be the contractual copy.

5) If required, two copies of all internal and external orders placed by the Contractor for equipment or materials required for the Works shall be forwarded to the Engineer at the time of issue. All orders shall state the Engineer's requirements for inspection and testing, shall bear the Contract reference, Contractor's name and address and shall indicate, where applicable, the sub-section of the Works for which the equipment or material is required.

6) Distribution of copies of the orders shall be in accordance with the Employer's Engineer's instructions.

7) The Contractor shall have the obligation to upgrade, at his own cost, all the relevant software to the latest version upon instruction by the Engineer, after the new version of the relevant software has been launched for more than six (6) months in Delhi.

8) The Contractor shall submit a drawing register to the Engineer in electronic copy and hard copy with each submission of drawings and at an interval agreed by the Engineer. The drawing register shall be in a format submitted for review and agreed without objection by the Engineer and shall include each document reference number, version, date, title and data-file name.

9) Specific additional requirements in respect of the numbering scheme shall be as defined in the PS.

4.2.2 **Content**

1) Unless otherwise specified or permitted by the Engineer, each submission shall comprise:

   i) for drawings - one coloured A1 master (signed by the contractor), one coloured A1 copy , two coloured A3 copies and an electronic scanned/data copy of all drawings ; and

ii) for documents - the bound coloured original, one bound coloured copy, one unbound coloured copy and an electronic scanned/data copy of all documents.

2) The A3 copies of drawings shall be produced as reduced versions of the A1 original.

4.3 Records and Reports

4.3.1 Reports and records that are to be submitted to the Engineer shall be in a format reviewed by the Engineer. Reports and records shall be signed by the Contractor's Representative or by a representative authorised by the Contractor.

4.3.2 Within 28 days of the Commencement Date of the Works, the Contractor shall submit a Project document control procedure to the Engineer for review, which shall include but not be limited to the following:

1) a document approval system which shall specify the level of authority for approval of all documents and material before submission to the Engineer;

2) a system of issuing documents to ensure that pertinent documents are issued to all appropriate locations;

3) a document changes or re-issue system to ensure that only the latest revision of a document can be used; and

4) a submission identification system which identifies each submission uniquely by the following:

a) contract number;

b) discipline;

c) submission number; and

d) revision indicator.

4.3.3 Project records will eventually be used by the Employer to manage, operate and maintain the Works after the completion of the Project under construction and for future reference.

4.3.4 The Contractor shall submit the documents as required by the Engineer as Project records in full and on time. The Engineer shall determine the adequacy of the Project record.

4.3.5 **Submission and Review Procedure**

1) Except where specific procedures are given for certain items, all submissions shall be submitted and reviewed according to the procedure laid down in the following clauses.

2) Each submission shall be accompanied by a brief introduction to explain which sub-system, part or Section of the Works to which the submission refers, listing the documents enclosed with the submission, and describing in outline how all relevant requirements of the Specification are achieved by the proposals.

3) For each stage of submittal, the Contractor shall prepare a Submission Review Request (SRR) carrying the date of submission, the submission reference number as defined in clause 4.3.2.(4) above, the submission title, the stage of submission (e.g. preliminary design, final design, etc.), and the authorised signature of the Contractor's responsible engineer in the format shown in APPENDIX 3 of this Specification, to confirm that, in the opinion of the Contractor, the submission:

i) complies with all relevant requirements of the Specification;

ii) conforms to all interface requirements;

iii) contains, or is based on auditable and proven or verified calculations or design criteria;

iv) has been properly reviewed by the Contractor, according to the Contractor's QA system, to confirm its completeness, accuracy, adequacy and validity; and

v) has taken account of all requirements for approval by statutory bodies or similar organisations, and that where required, such approvals have been granted.

4) The Engineer's response to the submission will normally be made within 21 days of receipt of the submission, provided that the submission is made no later than the date shown on the Submissions Programme described in clause 2.5 above. The Engineer may extend the review period depending on the amount of documentation accompanying the submission.

5) Throughout the design period, the Contractor shall attend monthly design review meetings with the Engineer. At these Engineer's review meetings, the Contractor shall present information, drawings and other documents to the Engineer in respect of all submissions programmed to occur during the following five week period. The Contractor's presentations shall be in sufficient depth to enable the Engineer to obtain a clear understanding of the Contractor's proposals and to discuss the methodology and process used in reaching the proposed design solutions. Unless directed otherwise by the Engineer, all meetings shall be convened in Delhi.

6) The Contractor shall record all of the Engineer's observations and any agreed actions resulting from the Engineer's review meeting and shall address each of these fully before submission of the respective documents for formal review.

7) If, in the Engineer's opinion, following receipt of a submission there is benefit to be gained from a meeting with the Contractor to clarify or discuss any of the contents of the submission, he will notify the Contractor accordingly with not less than 5 days advance notice, and the Contractor shall attend at the time and place appointed by the Engineer.

8) No submission may be made by the Contractor in respect of the Works or any sub-system, part or Section thereof unless a notice of no objection has been received for the previous stage of the same Works or any sub-system, part or Section thereof.

4.3.6 Engineer's Response

1) The Engineer will respond in one of the following three ways:

i) "Reviewed without Objection"

ii) "Reviewed without Objection, Subject to"

iii) "Rejected"

2) If the Engineer, having reviewed the submission, has not discovered any non-compliance with the Contract, the SRR will be returned endorsed with the Engineer's signature and the words "Reviewed without Objection". Receipt of such notice of no objection does not in any way imply the Engineer's approval of the submission, nor does it remove any responsibility from the Contractor for complying with the Contract. Issue of a "Notice of No Objection" entitles the Contractor for milestone payment and to proceed to the next stage of the programme of work.

3) If the Engineer discovers minor non-compliance, discrepancies, omissions, etc. that, in his opinion, are not of a fundamental nature, he may return the SRR endorsed with the Engineer's signature and the words "Reviewed without Objection Subject to" and including a list of the features that are required to be amended, included or improved to comply with the Contract. Issue of a "Notice of No Objection Subject to" entitles the Contractor for milestone payment and to proceed to the next stage of the programme of work provided that all of the Engineer's comments are taken into account fully and implemented exactly.

4) If the Engineer issues a "Notice of No Objection Subject to", the Contractor shall resubmit the affected parts of the submission, clearly demonstrating how the Engineer's comments have been taken into account and resubmit amended or corrected material within 28 days of issue of the Engineer's comments, using the process described in clause 4.3.5 above.

5) If the Engineer discovers major non-compliance, discrepancies, omissions, etc. that, in his opinion, are of a fundamental nature, he may return the SRR endorsed with the Engineer's signature and the word "Rejected" and including a list of the features that are required to be amended, included or improved to comply with the Contract. Issue of a "Notice of Rejection" does not entitle the Contractor to proceed to the next stage of the programme of work until all of the Engineer's comments are fully taken into account and a satisfactory re-submission has been made (i.e. one which results in a "Notice of No Objection" or "Notice of No Objection Subject to").

6) If the Engineer issues a "Notice of Rejection", the Contractor shall resubmit the complete submission, clearly demonstrating how the Engineer's comments have been taken into account and resubmit amended or corrected material within 28 days of issue of the Engineer's comments, using the process described in clause 4.3.5 above.

4.4 Records

4.4.1 The Contractor shall establish and maintain a place for the storage and archiving of all the documents relating to the Works and are not required to be submitted to the Engineer which shall be:

1) the same place or office where the Contractor is performing the work and storing documents reviewed by the Engineer, or;

2) at the Site or elsewhere in Delhi, a records office, which contains all other, documents that the Contractor is required to maintain in accordance with the Contract.

4.4.2 All documents shall be filed, indexed and suitably stored to permit easy identification and necessary audits.

4.4.3 The Contractor shall maintain in Delhi his archive of all documents in connection with and arising out of the Contract, until 28 days after the issue of the Final Certificate or until final settlement of all Disputes, whichever is later.

* End of Chapter *

CHAPTER 5

5. QUALITY MANAGEMENT

5.1 Introduction

5.1.1 The Contractor shall maintain and implement a Quality Management System that shall remain in effect during the execution of the Works. The Contractor's Quality Management System shall be based on the latest revision of International Standard ISO 9001 "Model for quality assurance in design, development, production, installation and servicing." The Contractor shall submit its Quality Management System documentation for the Engineer's review as specified in this Chapter.

The Quality Management System documentation shall include, but shall not be limited to the following:

1) quality manual;
2) quality procedures and work instructions;
3) quality plans; and
4) inspection and test plans.

5.1.2 The Contractor shall plan, perform and record all quality control activities to ensure that all work is performed in accordance with the requirements of the Contract and is detailed in the quality plans which are required under this Chapter. Such activities shall include, without limitation, the inspections and/or tests expressly or implicitly required by the Contract.

5.1.3 Without prejudice to such requirements, the Engineer may from time to time instruct the Contractor in relation to such further or other inspections and/or tests as are in his opinion appropriate.

5.1.4 Quality audits will be conducted by the Engineer to verify the Contractor's implementation and compliance with the quality management system as specified herein.

5.2 General Requirements

5.2.1 All quality system documents and plans to be submitted shall embrace all activities of the Contractor and sub-contractors of any tier, including its suppliers and any design consultants.

5.2.2 Quality Plans

1) The quality plans to be submitted by the Contractor shall comprise of:

   i) a Management Quality Plan, for the control of all management related activities;

   ii) a Design Quality Plan, for the control of all design related activities for the Works, including Temporary Works; and

   iii) Manufacturing Quality Plan and Site Quality Plan, for the control of activities within each category of work or discrete element of procurement, manufacturing, delivery, construction and installation of the Works, including Temporary Works.

5.2.3 Within 28 days of the Commencement Date of the Works, the Contractor shall submit for review by the Engineer a Quality Plan including.

1) a quality manual;

2) the quality system procedures and any associated system instructions and/or forms which he proposes to use for the Works; and

3) the initial submission of quality plans shall be a development of that submitted at Tender stage and shall contain as a minimum, the Contractor's proposed Management Quality Plan and a Design Quality Plan as detailed further in this Chapter.

5.2.4 The Contractor shall submit separate Manufacturing Quality Plan and Site Quality Plan covering all elements of the Works. These shall be in accordance with the specific requirements of this Chapter and shall be submitted to the Engineer for review 56 days prior to the commencement of the manufacturing and construction works covered by the quality plans. In addition, the Contractor shall prepare inspection and test plans for the management and control of the inspection and/or testing by the Contractor of the Works identified in each quality plan.

5.2.5 The Contractor shall promptly supply the Engineer with two (2) controlled copies of his quality manual, quality plans, inspection and test plans and related procedures/instructions/forms upon such documents being reviewed without objection by the Engineer. The Contractor shall maintain such controlled documents throughout the duration of the Contract.

5.2.6 The detailed plan shall be updated as necessary from time to time to incorporate, to the Engineer's satisfaction, all changes to the Contractor's procedures. For any amendment to quality system documentation, the Contractor shall as soon as reasonably practical prepare and submit the proposed amendment for review by the Engineer. In addition, the Engineer may request further copies of the quality system documents and these documents shall reach the Engineer's office within fourteen (14) days of notification.

5.2.7 The Contractor shall appoint (a) suitably qualified and experienced person(s) as Quality Manager(s), who shall be directly responsible to senior management level and is able to discharge his duties without hindrance or constraint, and provide such other resources as may be required to ensure effective implementation of the Quality Management System and all quality plans. Details of the qualifications, experience, authority and responsibility of the proposed Quality Manager(s) shall be submitted for review by the Engineer within 28 days of the Commencement Date of the Works.

5.2.8 During the Contract period, upon receipt of a Corrective Action Request (CAR) or similar document issued by the Engineer as a result of quality audits, the Contractor shall submit a proposed corrective and preventive action plan within 14 days to the Engineer for review.

5.3 Management Quality Plan

5.3.1 The Management Quality Plan shall define the Contractor's management structure for the execution of the Works and for the control of the quality of the Works and shall, without limitation, define:

1) The appointment of a Quality Manager in accordance with clause 5.2.7 above;

2) The organisation of the Contractor's managerial staff with particular reference to any joint venture partners and main sub-contractors. An organisation chart shall be produced to illustrate the sub-division of the Works into elements for effective technical and managerial control, the reporting structure and the interface relationship between all parties involved;

3) The hierarchy of the overall quality management system documentation to be applied to the Works;

4) The quality management system of the Contractor in monitoring and controlling sub-contractors and suppliers; and

5) The list of quality system procedures and work instructions to be applied to manage the quality of the Works.

5.4 Design Quality Plan

5.4.1 The Contractor shall prepare a Design Quality Plan for its design works. The Design Quality Plan shall define the Contractor's policy for the design works and shall, without limitation, define:

1) the organisation of the Contractor's design staff;

2) the specific allocations of responsibilities and authorities given to identified design staff or sub-contractors for particular design work;

3) the hierarchy of quality management system documentation for managing and controlling design works, including design works of sub-contractors of any tier; and

4) the list of procedures and instructions to be applied to manage and control the quality of the design works.

5.5 Manufacturing Quality Plan

5.5.1 The Contractor shall prepare a Manufacturing Quality Plan for his manufacturing works. The Manufacturing Quality Plan shall, without limitation, define:

1) the organisation of the Contractor's staff directly responsible for the day-to-day management of the manufacturing activities on or off the Site;

2) the specific allocations of responsibilities and authorities given to identified personnel or sub-contractors for particular manufacturing work;

3) the hierarchy of quality management system documentation for managing and controlling manufacturing works, including manufacturing works of sub-contractors of any tier; and

4) the list of procedures and instructions to be applied to manage and control the manufacturing works, together with the procedures and instructions which have not been previously submitted for review.

5.5.2 The Contractor shall also prepare inspection and test plans to manage and control any test and inspection activities in accordance with clause 3.5.3 above.

5.6 Site Quality Plan

5.6.1 The Contractor shall prepare a Site Quality Plan for its construction and installation works. The Site Quality Plan shall, without limitation, define:

1) the organisation of the Contractor's staff directly responsible for the day-to-day management of the construction and installation activities on or off the Site;

2) the specific allocations of responsibilities and authorities given to identified personnel or sub-contractors for particular construction and installation work;

3) the hierarchy of quality management system documentation for managing and controlling construction and installation works, including construction and installation works of sub-contractors of any tier; and

4) the list of procedures and instructions to be applied to manage and control the construction and installation works together with the procedures and instructions that have not been previously submitted for review.

5.6.2 The Contractor shall also prepare inspection and test plans to manage and control any test and inspection activities in accordance with clause 5.7.1 below.

5.7 Inspection and Test Plans, Records and Reports

5.7.1 Inspection and test plans shall be produced for every activity requiring test and/or inspection. Each inspection and test plan shall identify the quality objectives and include, without limitation:

1) the personnel responsible for undertaking and certifying the inspection and/or test;

2) the procedure or instructions for the inspection and/or test;

3) the test method or a reference to the relevant standard of testing;

4) the inspection and/or test required prior to commencement of an activity;

5) the inspection and/or test during an activity and its frequency;

6) the inspection and/or test required to complete an activity;

7) all Quality Control Points, Quality Hold Points and any notices or other documents to be given to the Engineer in relation to Quality Control Points and Quality Hold Points;

8) the compliance criteria;

9) the method of analysis of test data;

10) the procedure for correction or disposal of any work which fails the compliance criteria;

11) examples of the documentation to be used for reporting the results of inspections, tests and analysis of test data;

12) examples of the documentation to be used for recording the status of inspections and tests in accordance with clause 5.9.1 below; and

13) the procedure for the distribution, filing and storage of inspection reports, test reports and reports on analysis of test data.

5.7.2 Each report of the inspection and/or test shall be prepared in accordance with clause 9.6.6(1) below.

5.7.3 The Contractor shall ensure that a signed copy of each report of inspection and test is filed in his filing system within 3 (three) working days of the date of inspection and test.

5.7.4 In relation to all Quality Control Points and Quality Hold Points involving inspection and/or test by the Contractor, the Contractor shall give the Engineer notice of when the relevant work will be inspected and/or tested in accordance with clause 9.8.1 below.

5.8 Review, Verification & Audit

5.8.1 The Contractor shall continuously monitor the performance of each quality plan related to the execution of the Works and shall include in each Monthly Progress Report the status of all quality system documentation, an up-to-date audit schedule and status and an up-to-date non-conformity register providing the status of all non-conformities identified by the Engineer and the

Contractor. The Contractor shall make an appraisal of such performance and identify in particular any non-conformities or other shortcomings in the quality management system, the actions being taken to dispose of these non-conformities, any necessary corrective action taken or proposed to be taken to prevent the re-occurrence of these non-conformities or shortcomings and, any other items as instructed by the Engineer.

5.8.2 The Contractor shall ensure that audits of all the activities in each quality plan are carried out at quarterly intervals, or at such other intervals as the Engineer may require, to ensure the continuing suitability and effectiveness of the quality management system. Reports of each such audit shall be submitted promptly for review by the Engineer.

5.8.3 The Contractor shall ensure that the requirements for supervision and verification of work by the Contractor and/or his sub-contractors of any tiers are identified in the quality plans and adequate resources and trained personnel are provided for these activities.

5.8.4 The Contractor shall submit for review by the Engineer details of the authority, qualifications and experience of personnel assigned to design verification and to audit activities.

5.8.5 The Engineer may, by notice to the Contractor, require external audits of the Contractor's quality management system to be carried out either by the Employer's staff or by his representative. In such case, the Contractor shall afford to such auditors all necessary facilities and access to the records to permit this function to be performed.

5.9 Quality Control Register

5.9.1 The Contractor shall provide and maintain at all stages of the Works a quality control register or registers to identify the status of inspections, sampling and testing of the work and all certificates. Such registers shall be updated by the Contractor to show all activities in previous months and shall reach the Engineer's office before the 7th day of each month. Each register shall:

1) list the certificates received for each batch of goods and materials incorporated in the Works and compare this against the certification required by the Contract and the Contractor's quality plans;

2) list the inspection and testing activities undertaken by the Contractor on each element of the Works and compare these activities against the amount of inspection and testing required by the Contract and the Contractor's quality plans;

3) show the results of each report of inspection and/or test and any required analysis of these results and compare these results against the pass/fail criteria; and

4) summarise any actions proposed by the Contractor to overcome any non-conformity identified in clauses 5.9.1(1)(2) & (3) above.

5.10 Summaries of Inspection and/or Test

The Contractor shall submit to the Engineer for his information summaries based on quality control register in accordance with the Summaries of Inspection and/or Test described in clause 9.6.11 below.

5.11 Notification of Non-conformities

5.11.1 If, prior to the issue of the Taking Over Certificate for the Works or the relevant Section, the Contractor has used or proposes to use or repair any item of the Works which does not conform to the requirements of the Contract, he shall immediately submit to the Engineer such proposal, supplying full particulars of the non-conformity and, if appropriate, of the proposed means of

repair which shall include any calculation analysis or other documentation to support the repair or acceptability of the non-conformity.

5.11.2 If the Engineer issues non-conformity reports or similar documents to notify the Contractor of any item of the Works which he considers to constitute a non-conformity and which has not been reported in accordance with clause 5.11.1 above, the Contractor shall promptly investigate the matter and, within 14 days of notification by the Engineer, submit to the Engineer for review the remedial measures to be taken and stating the reasons for such measures.

* End of Chapter *

CHAPTER 6

6. SOFTWARE MANAGEMENT AND CONTROL

6.1 Prescriptive Framework

6.1.1 The Contractor shall, within 56 days of Notice to Proceed, submit a Software Quality Assurance Plan for review by the Engineer.

6.1.2 All software to be developed or modified (re-engineered software) shall follow the normative requirements of EN50128 (Railway Applications: Software for Railway Control and Protection Systems). The Software shall be designed, developed and tested according to the Software Quality assurance Plan, Software Integrity Level (SIL) and the Software Lifecycle.

6.1.3 The Contractor shall define within the Software Quality Assurance Plan what techniques and measures are to be applied for software development. In addition to the requirements of the Software Quality Assurance Plan, justification, which shall be reviewed without objection by the Engineer, shall be required in respect of any highly recommended EN50128 Annex A normative clauses which are not to be applied to software development and supply.

6.1.4 The Plan shall require the Contractor to provide all changes, bug fixes, up-dates, modifications, amendments and new versions of the programmes, as required by the Engineer. Engineer may also direct to provide the copy of previous version of software till such time the new version of software is proven.

6.1.5 The Contractor shall provide all tools, Laptop computers or any special device to upload / download the software/Train logs/data, equipment, manuals and training necessary for the Employer and Engineer to maintain and re-configure all software provided under this Contract.

6.1.6 The Software shall be without any bugs. When a fault is discovered in delivered software, or an error in the associated documentation, the Contractor shall take the necessary steps to rectify such faults and errors at the earliest opportunity. The Contractor shall supply to the Engineer, full details, in writing, as to the nature of the corrective action proposed or taken. These changes shall be documented.

6.1.7 It will be incumbent upon the Contractor to take responsibility for any changes required to software.

6.2 Software Framework

6.2.1 As defined in EN50128, all software produced or supplied for the project shall be subject to a defined quality framework. The Contractor shall use a Quality Assurance System which is compliant with CENELEC specifications and meet the requirements as stipulated in the PS. ISO 9000-3 shall be considered appropriate for low criticality software (safety integrity level 0 or 1) whilst the application of a more stringent framework shall be required for higher criticality software (safety integrity level 2 or above). The quality framework requirements for safety integrity level 2 and above are supplementary to the requirements of EN 50128.

6.2.2 SIL level of all software used in different sub systems shall be defined and certified.

6.3 Software Management Control

The Contractor shall ensure that a full time Software Contractor's Representative and Software Quality Manager are appointed for software development, if software development and/or

modification are required under the Contract.

6.4 Status Reporting

The Contractor shall include in the Monthly Progress Report details of the status of the software development/modifications/upgrades.

6.5 Auditing

The Engineer shall audit the Contractor in line with Employer's procedures. Further external independent audits may also be arranged at the Engineer's discretion.

6.6 Software Acceptance

6.6.1 Software acceptance shall be based upon the supply of software functioning in a manner reviewed without objection by the Engineer supported by an Operational Safety Report (Software) reviewed without objection by the Engineer. The report shall be provided by the Contractor and submitted to the Employer's Engineer for review in the format described below. All the documents for the design, development, testing, verification and validation as defined in CENELEC standards including EN50128 shall be submitted. The Engineer's review without objection shall be obtained prior to Employer's Taking Over of the Works.

6.6.2 The Operational Safety Report (Software) (OSR(S)) shall include, as a minimum:

1) **OSR(S) - Introduction**

   Shall describe the nature of the software sufficiently to ensure that the Engineer is given a comprehensive overview of primary characteristics such as structure, functions, criticality, volume and language.

2) **OSR(S) - Evidence of Quality Management**

   Shall provide evidence to demonstrate that the software development has been subject to acceptable quality assurance.

3) **OSR(S) - Evidence of Safety Management**

   Shall provide evidence to demonstrate that the software development has been subject to acceptable safety management.

4) **OSR(S) - Technical Report**

   Shall describe how software integrity has been achieved.

5) **OSR(S) - Operation and Maintenance Report**

   Shall describe the software operation and maintenance characteristics.

6) **OSR(S) - Restrictions for Use**

   Shall define what restrictions are applied to the use of the software.

6.7 Not used

6.8 Re-Use of Existing Software

6.8.1 Where existing software (defined to module level) is to be re-used without modification, the Contractor shall provide evidence acceptable to the Engineer as to why that software is suitable for use in the proposed application. All software developed earlier and intended to be used for the Contract shall meet the requirements laid down in the PS.

6.8.2 The evidence may be historical(Certified evidence of previous satisfactory use in a similar environment and application) or it may be cross acceptance from another railway authority/ Statutory body shall be submitted. The Engineer reserves the right to implement an assessment of the developed software by further validation or re-validation by an outside agency nominated by the Employer.

6.9 Application of "Commercial Off The Shelf" Software (COTS)

COTS shall not be applied to any application software at level SIL2 and above. Where COTS is used, the Contractor shall define within the SQAP, to the review of the Engineer, the software support period following delivery. The software support activities shall include but not be limited to, supply of software and supporting documentation, training and maintenance contracts.

For COTS, the contractor shall provide all available documentation for the application and maintenance of that software along with necessary framework

6.10 Not Used

6.11 Test Software

All test software, with the exclusion of built-in test software, shall be produced in accordance with a quality system controlled under the requirements of ISO 9000-3. Test software shall be developed and documented using structured techniques and shall be designed to be maintainable throughout the term of the Contract. All test software shall be documented to be supportive of maintenance. Any test software that is to be delivered to the Employer (for long term testing use) shall be fully documented including source code listings to allow the Employer to maintain the software for the life of the supported system.

6.12 Global Positioning System Week-counter Rollover

Any equipment or software that makes use of the Global Positioning System (GPS) shall not suffer from the GPS week-counter rollover problem, which causes the week counter to reset to 0000 every 1024 weeks.

6.13 Software Rights

The Contractor shall ensure that the Employer is granted all necessary rights to use Software embodied in the equipment and there are no restrictions attached to the use of any information supplied by the contractor which might later prevent or hinder the Employer from modifying or adopting or extending the system. The Contractor shall indemnify the Employer against claim of any party, sub-contractor for the unauthorised possession or use of the software supplied.

* End of Chapter *

CHAPTER 7

7. MATERIALS AND EQUIPMENT

7.1 Materials and Equipment Provided by the Employer

7.1.1 Materials and equipment which are to be provided by the Employer will be as stated in the Contract.

7.1.2 Materials and equipment provided by the Employer shall be collected by the Contractor from the locations stated in the Contract and delivered by the Contractor to the Site. The Contractor shall inspect the materials and equipment before taking receipt and shall immediately inform the Engineer of any shortage or damage.

7.1.3 Materials or equipment provided by the Employer which are damaged after collection shall be repaired by the Contractor and submitted to the Engineer for review. Materials or equipment which are lost or which in the opinion of the Engineer are not capable of being or have not been repaired satisfactorily shall be replaced by the Contractor.

7.1.4 The Contractor shall dispose of crates and containers for materials or equipment provided by the Employer.

7.1.5 Equipment / materials provided by the Employer, surplus to the requirements of the Works shall be returned to the locations stated in the Contract.

7.1.6 The Contractor shall protect and maintain equipment provided by the Employer while it is on the Site and shall provide operatives, fuel and other consumables required to operate the equipment.

7.2 Materials

7.2.1 General

1) Materials for inclusion in the Permanent Works shall be new unless otherwise stated in the Contract or having been reviewed without objection by the Engineer.

2) Certificates of tests by manufacturers, which are submitted to the Engineer, shall relate to the material delivered to the Site. Certified true copies of certificates may be submitted if the original certificates cannot 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) Materials, which are specified by means of trade or proprietary names, may be substituted by materials from a different manufacturer, provided that the materials are of the same or better quality and comply with the specified requirements and have been reviewed without objection by the Engineer.

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. 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. Such samples, if having been reviewed with 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 without objection.

5) The Engineer may reject any materials and goods which in his opinion are inferior to the samples previously reviewed and the Contractor shall promptly remove such materials and goods from the Site.

6) If any material required for this Contract is not available in metric specifications from any known sources, at the time the material is required for the Contract, the Engineer may, upon application from the Contractor, give permission to the use of an equivalent material in imperial specifications as a substitute, provided that:

   i) no statutory specification shall be altered except in accordance with relevant legal provision, if any;

   ii) the Engineer is satisfied that the Contractor has made every reasonable effort to obtain the material in metric specifications;

   iii) in the opinion of the Engineer, the substitute material is suitable for the Works in all respects;

   iv) in the opinion of the Engineer, the substitute material complies with all the specifications for the material substituted, allowing minor discrepancies between the specified metric measurements and the corresponding imperial measurements of the substitute, provided that such discrepancies can be effectively and satisfactorily compensated for by the provision of extra quantity of the material; and

   v) the Contractor shall be responsible for all extra quantities of the material required for meeting design and specification requirements of the Works due to the use of the substitute.

7) Hardwood shall not be used for Site hoardings, shoring of trenches and pits, falsework or formwork.

7.2.2 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 previously reviewed without objection by the Engineer to be incorporated into the Permanent Works. The Contractor shall give reasonable notice (which shall not in any event be less than 56 days) to the Engineer before the start of any manufacturing and/or the supply of goods and materials.

7.2.3 Certificates for Manufactured Goods or Materials

The Contractor shall obtain certificates for each batch of goods and materials incorporated 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.

7.3 Equipment

7.3.1 Identification labels

1) Each and every individual item of equipment forming part of the Permanent Works shall be fitted with permanent identification labels in accordance with a system based on the contract identification. In this respect, the term “individual item of equipment” refers to a complete assembly of components and to each removable sub-module within the complete assembly.

2) The labelling system shall mandatory have QR code for equipment identification along with human readable code. QR code format shall be in accordance with specifications of WAMS (Work and Asset Management).

3) The proposed labelling system shall be submitted for review by the Engineer at least 3 months before the scheduled date for the shipment of the first item of equipment to site.

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 embossed or engraved metallic labels mechanically fastened by riveting or similar means to the item to which they refer.

5) All labels shall be easily cleaned to remove dirt and debris (including grease and oil) without disturbing the legibility properties.

6) All labels shall incorporate the inscription “Property of D.M.R.C”.

7.4 Electronic Control Racks & Cabinets

7.4.1 Racks & Cabinets

1) Electronic control equipment shall be housed in 19" racking suitably enclosed in metal cabinets of a type acceptable to the Engineer. A sample of each type of rack or enclosure proposed shall be submitted to the Employer’s Engineer for inspection.

2) The equipment shall be of modular construction to facilitate maintenance, repair and replacement of parts. Standard commercial parts shall be utilised to the maximum extent possible.

3) Cubicles, Equipment Racks, cable and wiring Termination Racks shall not be filled to greater than 80% of their capacity at the completion of the works.

4) The equipment shall be suitable for the environment in which it is to be used and it shall be designed to prevent ingress of all vermin and to minimise the ingress of moisture, dust and dirt.

5) As far as possible, there shall be a minimum walkway of 1000mm between equipment rack array

6) Outdoor equipment shall be sealed against the ingress of dust, moisture and vermin.

7) No item of equipment which is removable as part of routine maintenance procedures shall be mounted at more than 2.0m above floor level.

7.4.2 Cables

1) No joints or splices shall be permitted in cables or wires except at recognised termination points.

2) All multi-core cables shall have 20% or 2 cores, whichever is the greater, as spare cores.

3) All cable cores shall be terminated including all spare conductors.

4) Each cable core shall be uniquely numbered and identified with a label giving details of the circuit carried.

5) Terminals carrying voltages exceeding 50 volts shall be uniquely identified and protected against accidental contact by persons, test equipment or other unintended physical contact. Similarly, all bus bars shall be suitably identified and protected.

∗ End of Chapter ∗

CHAPTER 8

8. PACKAGING, STORAGE, SHIPPING AND DELIVERY

8.1 Storage of Equipment

8.1.1 The Contractor shall provide and maintain acceptable storage facilities for the Permanent Works, equipment and materials of all kinds intended for use in carrying out the Works or for incorporation into the Works.

8.1.2 The Contractor shall prepare, protect and store in an agreed manner all Permanent Works, Contractor's Equipment, equipment and materials so as to safeguard them against loss or damage from repeated handling, from climatic influences and from all other hazards arising during shipment or storage on or off the Site.

8.1.3 Secure and covered storage shall be provided by the Contractor for all Permanent Works, Contractor's Equipment, equipment and materials which are other than those having been reviewed without objection by the Engineer as suitable for open storage.

8.2 Crating

8.2.1 The Contractor shall provide all packing, crates and markings. In doing so, it shall comply with the following requirements: -

1) Each case, crate or package shall be waterproof, rot-proof and insect/rodent-proof, of robust construction and suitable for the intended purposes. The Contractor shall, in determining the package materials to be used, take cognisance of the climatic conditions likely to occur during the period of transport, shipment and storage.

2) Each case, crate or package shall be legibly and indelibly marked in large letters with the Site address, Contract number, "right way up", opening points and other markings as necessary to permit materials to be readily identified and handled during transit and when received at the Site.

3) Each case, crate or package shall contain a comprehensive packing list showing the number, mark, size, weight and contents together with any relevant drawings. A second copy of the packing list shall be enclosed in a watertight enclosure on the outside of each case or package. Distribution of additional copies of each packing list shall be in accordance with the Engineer's instructions.

4) All items heavier than 100 kg shall be marked on the outside of the case to show the gross and net weights, the points for slinging, and where the weight is bearing.

5) Care shall be taken to prevent movement of items within cases, crates or packages by the provision of bracing, straps and securing bolts as necessary. Bags of loose items shall be packed in cases, and shall be clearly identified by well-secured metal labels on which the quantity and name of the part and its index or catalogue number have been stamped.

6) Plug connected electronic circuit boards shall be removed from their racks, packed and shipped separately.

   i) All packing shall be free from sharp edges to prevent injury to persons or other objects.

   ii) Each bulky/heavy case, crate or package shall include (a) wedge(s) for easy loading and unloading by mechanical handling equipment such as forklift truck.

iii) Electronic circuit boards, integrated circuits (IC) and the like shall be well protected by using appropriate packing, e.g. anti-static bubble bag or similar.

iv) Rubber products and the like shall be suitably packed to avoid damage including but not limited to hardening, deformation and peel-off.

8.3 General Precautions

8.3.1 Spare parts shall be tropicalised in their packing for prolonged storage in accordance with BS 1133 or other equivalent International /Indian standard and shall be suitably and individually labelled to indicate:

1) shelf life and date of manufacture;
2) type or condition(s) of storage and special handling information;
3) description of item and relevant part number;
4) serial number, if applicable;
5) inspection/test certificate number and batch number; and
6) Contract number, variation order number and item number.

8.3.2 Tubes, cables, and other similar openings shall be properly sealed and blanked off to prevent ingress of dirt or moisture. Flanged ends shall be protected by adhesive tape or jointing material covered by a properly secured wooden blank not smaller than the flange itself. Plain tube ends shall be closed off with bungs or plugs or suitable materials firmly fixed in position.

8.3.3 Particular care shall be taken to prevent mechanical transport related damage or corrosion of shafts and journals where they rest on timber or other supports which may contain moisture. At such points, wrappings impregnated with anti-rusting composition and of sufficient strength to resist chafing under the pressures and movements during transit shall be used.

8.3.4 Spare ball and roller bearings and similarly protected items shall not be removed from the manufacturer's wrappings or packing.

8.3.5 Fragile materials shall be packed in such a way that they shall not be damaged during transit and when they are properly unpacked for quality inspection. Glass items shall be capable of being easily re-packed without removing the original wrappings or packing for long-term storage within the same packing case.

8.3.6 Appropriate precautions in accordance with the Contractor's safety regulations, the regulations of the Employer, and statutory regulations shall be taken in respect of all hazardous, toxic, inflammable, etc. materials.

8.4 Packaging Procedures

8.4.1 All required inspection/test certificates shall be supplied and packed together with individual material. All packaging materials and procedures shall be subject to review by the Engineer.

8.4.2 All empty cases, crates or packages, whether or not returnable, shall be removed from the Site by the Contractor or stored by the Contractor in such a way that they do not interfere with the progress of the works of Project Contractors.

8.5 Shipping

8.5.1 The Contractor shall notify the Engineer seven days in advance of any expected shipment date and give further notification of the actual shipment date and routing when such information is subsequently established. This shall complement the inspection requirements prior to delivery as specified herein.

8.5.2 Two copies of packing lists and quality certificates shall be attached to each case or package to be shipped. One copy shall be placed inside the package and the second copy shall be enclosed in a watertight enclosure on the outside of each case or package. A copy of packing lists and quality certificates shall be sent to the Engineer after each package of the Works, the equipment, spare parts and other items to be shipped have been shipped.

8.5.3 Without prejudice to any other provisions of the Contract, the Contractor shall be responsible for all legal requirements, duties, dues, taxes and other such requirements and expenditures required for the importation of the Works, the equipment, spare parts and other items to be supplied under the Contract into Delhi.

8.5.4 The Contractor shall clear the Works, the equipment, spare parts and other items to be supplied under the Contract through Delhi customs/Indian sea port in accordance with all Government of India Enactments.

8.6 Delivery

8.6.1 The Contractor shall deliver the Works and all items to be supplied under the Contract to the Site.

8.6.2 The Contractor shall unload the Works and all items to be supplied under the Contract at the designated delivery point and position or store them.

8.6.3 Any part of the Works or any item to be supplied under the Contract that is damaged in transit shall not be considered as delivered until repairs or replacements have been made and all necessary spare parts or items have been delivered to the Site.

8.6.4 All documents, manuals, drawings and other deliverables shall be delivered to an address in Delhi to be designated by the Engineer in writing.

8.6.5 The Contractor shall store and secure the Works, equipment, spare parts and other items until the same have been inspected and are considered delivered at the designated point by the Engineer.

8.6.6 The Contractor shall remove temporary fittings required for shipment and re-assembly of equipment and shall complete this prior to the equipment or parts thereof being inspected and before they are considered delivered.

8.6.7 An item shall be considered delivered when all damage has been repaired and all documentation and post-delivery preparation have been completed to the satisfaction of the Engineer.

∗ End of Chapter ∗

CHAPTER 9

9. TESTING AND COMMISSIONING

Testing and Commissioning shall comply with all the requirements of the GC supplemented, amplified, modified or superseded as applicable by this Specification and the PS.

9.1 General

9.1.1 The Contractor shall perform all testing and commissioning activities to satisfactorily demonstrate the performance of the Works within the framework of the Completion Management Plan.

9.1.2 The Contractor's activities shall include but are not limited to the following:

1) provision of all labour and experienced supervision to perform all inspections and tests required to demonstrate the performance of the Works;

2) preparation of that portion of the Commissioning Plan that applies to the Works to a level of detail acceptable to the Engineer;

3) performance of all duties and responsibilities, as specified in the Commissioning Plan;

4) participation in the Commissioning Team that shall develop, review and implement the Commissioning Plan. As a participant of the Commissioning Team, the Contractor shall provide personnel and technical support to the Employer and the Engineer in the Commissioning of the Project;

5) performance of the testing and commissioning for all systems forming part of the Works in a manner which is fully co-ordinated with other Contractors, the Employer and the Engineer;

6) provision of all required testing and specialised equipment and materials including consumables required to support the testing and commissioning pre-operations activities; and

7) removal and appropriate disposal of any toxic or other spoils (e.g. cable drums, depleted filters, oils, and fluids) created as a result of the Contractor's construction, testing and commissioning activities.

9.1.3 The Contractor shall provide full access for the Employer and Engineer to witness any test or inspection.

9.1.4 The Employer and the Engineer will bear their own costs for attendance at witnessed inspections or tests (other than re-tests) scheduled in accordance with the agreed Works Programme and subject to notice in accordance with the Specification.

9.2 Manufacturing Test Plan

9.2.1 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 the Engineer are in compliance with the requirements of the Specification.

9.2.2 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 referred to in clause 5.5 above.

9.2.3 The Employer and the Engineer will not become involved in the Contractor's Manufacturing Tests except in respect of the following:

- **Type Tests**; and
- **First Article Inspection**.

9.2.4 Before shipment of any items to Site the Contractor shall present the items for the first stage of Acceptance according to the Commissioning Plan as detailed in clause 9.3 below.

9.2.5 **Inspection**

1) The Contractor shall be wholly responsible for all inward inspection of items to be incorporated into the system as a whole.

2) Equipment issued by the Employer shall not be subject to **Type Tests** or **First Article Inspection** however the Contractor shall undertake Inspection as referenced in clause 7.1 above. Should the Employer's issued equipment be subsequently incorporated into another manufactured item then the whole item shall be subject to both **Type Tests** and **First Article Inspection**.

9.2.6 **Type Tests**

1) Type tests will not be required in those cases where the Contractor can produce certified evidence that the required type tests have been performed successfully on identical equipment or equipment which is, for practical test purposes, similar and produced in the factory where the equipment offered is to be manufactured.

2) Evidence to this effect submitted during the Tender period shall be resubmitted, this and any further submissions for waiver of Type Testing for review by the Engineer's Representative no later than two months before the scheduled date for shipment of the item to site.

3) Unless specified to the contrary, equipment type testing shall consist of performing the tests listed below on at least one sample of the design:

i) Mechanical Tests - Based on the function to be performed as laid down in the PS;

ii) Environmental Tests - Based on the class of environment into which the item is to be installed;

iii) Functional Tests - To comply with the requirements of the PS;

iv) Electrical Tests - (where appropriate) To demonstrate compliance with electrical characteristics under conditions of interference and power supply disruption; and

v) Fatigue (Soak) Tests - To demonstrate the reliability or longevity of the item.

4) Type tests are not required if previously independently witnessed tests have been successfully carried out. Where only some of the required tests have been carried out, the Engineer may agree to selected type tests being carried out individually rather than as part of a sequence.

5) The Contractor shall conduct the tests in accordance with the reviewed test procedures, and shall enter the results in the result sheets. Full use shall be made during the tests of operator manuals and other documentation provided by the Contractor, to provide a series of tests of their accuracy.

6) Various requirements for typical Type Tests are included in Appendix 5 of this specification.

7) 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.

8) 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.

9.2.7 **First Article Inspection**

1) FAI shall be performed jointly by the Employer and the Engineer and the Contractor on all major equipment items or sub-systems identified by the Engineer.

2) Equipment shall be shipped from the point of manufacture only after a FAI has been completed or the requirement waived in writing by the Engineer.

3) The Contractor shall provide a minimum of 14 working days' notice to the Engineer before any FAI. Other than the FAI, the Contractor shall give the Engineer notice of all Quality Control Points and Quality Hold Points involving inspections and/or tests by the Contractor in accordance with clause 9.8.1 below.

4) At least 14 days prior to each FAI, 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 complete to the lowest level replaceable unit.

5) The Contractor shall ensure that he and his subcontractors are prepared for all FAIs. The Contractor shall not schedule more than one FAI on the same day without prior notice of No Objection by the Engineer.

6) The FAI shall evaluate component and system maintainability. The FAI shall enable the Employer and the Engineer and the Contractor to jointly establish the quality of workmanship for the balance of like components.

7) The FAI shall not be conducted until the design drawings of the equipment have been reviewed. If drawings with outstanding comments are used, the Engineer's comments shall be satisfied at the FAI and represented by the inspected equipment.

8) FAI shall be performed on a component built using reviewed without objection production processes, tooling and manpower. All test fixtures, programs and instruments used in FAI shall be those to be used in the routine production testing of subsequent identical items.

9) The Contractor shall be responsible for the cost and scheduling, to the Employer and the Engineer's convenience, of any repeat testing of items which fail FAI.

9.2.8 **Factory Acceptance Test**

1) Before shipment all manufactured items or systems shall undergo FAT in accordance with the requirements of the PS. The First Article Inspection Test can also be clubbed as part of FAT, if agreed by the Engineer.

9.3 Commissioning Plan

9.3.1 The Commissioning Plan is the Employer and the Engineer's tool for managing and co-ordinating the Testing, Commissioning, Training and Service Trial activities. The Commissioning Plan will be divided into the following sub-plans:

1) Factory Testing Plan (see clause 3.5.3 above and PS)

2) On-Site Testing and Commissioning Plan

9.3.2 Testing and Commissioning Phases

1) Testing and Commissioning activities shall be undertaken in the following phases:

   i) **Factory Acceptance Test** (the requirements are specified in clause 3.5.3 above);

   ii) **Installation Tests**;

   iii) **Partial Acceptance Tests**;

   iv) **System Acceptance Tests**;

   v) **Integration Testing & Commissioning**; and

   vi) **Service Trial**.

2) Items (iii), (iv), (v) and (vi) as required by the PS constitute the Tests on Completion referred to in the GC.

9.4 On-Site Testing and Commissioning Plan

9.4.1 The Contractor shall prepare and submit for review 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.

9.4.2 The On-Site Testing and Commissioning Plan shall contain, but not be limited to, the following topics:

1) 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;

2) the sequencing and interrelationships of the inspections and tests including:

i) all Quality Hold Points; and

ii) all Quality Control Points;

3) the interdependency and interaction with other Contractors and their commissioning programmes;

4) the type and extent of testing and commissioning to be undertaken and the parts of the Works to be proven by that testing;

5) 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;

6) organisation chart and CV of key personnel in testing and commissioning team;

7) the plan for the production and submission of the testing and commissioning procedures to the Engineer for review including the submission of the testing and commissioning reports and records; and

8) the On-Site Testing and Commissioning Plan shall be organised and submitted in the stages described in clauses 9.3.2 above, 9.4.3 below & 9.4.7 below.

9.4.3 **Installation Tests**

1) The Installation Tests phase 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.

2) 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 liase with the interfacing party to co-ordinate the test procedures and programme in the manner prescribed in clause 3.3.2 above.

3) The Contractor shall prepare three copies of a test report immediately after the completion of each test whether or not witnessed by the Employer or the Engineer. If the Employer or the Engineer has witnessed the test, he will countersign the report to indicate his agreement to the information and conclusions (i.e. whether or not the equipment being tested has passed satisfactorily) contained therein. If the Employer or the Engineer has not witnessed the test (i.e. if a written waiver has been granted), the Contractor shall forward two copies of the test report without delay to the Engineer.

4) The Engineer will countersign the report to indicate his agreement to the information and conclusions (i.e. whether or not the equipment being tested has passed satisfactorily) and return one copy to the Contractor. Where the results of the test do not meet the requirements of the Specification, the Employer or the Engineer may call for a re-test.

5) Test equipment and instrumentation shall be subject to calibration test within a properly controlled calibration scheme, and signed calibration certificates shall be supplied to the Engineer. Such calibration checks shall be undertaken prior to testing and, if required by the Employer or the Engineer, shall be repeated afterwards.

6) The Contractor shall submit to the Engineer a comprehensive schedule of tests as required by the PS 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).

9.4.4 Partial Acceptance Tests

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 on Completion to be performed by the Contractor under the Contract in order to achieve Employer's Taking Over of the Works. 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, 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 PS (or if none is given, no later than two months before the commencement of the commissioning work whichever is earlier), 2 copies of its proposed Partial Acceptance Tests sheets. The Test sheets 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 certified by the Employer or 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 licences 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 Contractor shall complete the appropriate Partial Acceptance Tests records in the agreed format and submit 2 signed copies to the Engineer.

10) The Contractor shall include a complete schedule of all Partial Acceptance Tests records and their current status within the Monthly Progress Report.

9.4.5 System Acceptance Tests

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) The tests shall include, but not be limited to, the following:

   i) tests of all functional and performance requirements for the system;

   ii) tests of behaviour under failure conditions, e.g. changeover to redundant hardware; initiation of re-configuration functions or reverse modes of operation; and recovery of the equipment and system from failure.

6) 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, and 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 acceptance testing of the system, the Contractor shall complete the appropriate commissioning records in the agreed format and submit 2 signed copies to the Engineer.

9) The Contractor shall include a complete schedule of all System Acceptance Test records and their current status within the Monthly Progress Report.

9.4.6 **Integration 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 the 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: -

   i) test of all functional and performance requirements for the system;

   ii) test to demonstrate compliance with all interface specifications; and

   iii) 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 Engineer, 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 3 signed copies to the Engineer.

9) The Contractor shall include a complete schedule of all Integrated Testing & Commissioning records and their current status within the Monthly Progress Report.

9.4.7 **Service Trial**

1) Service Trial is defined as the final test of the fixed equipment, the rolling stock, and the operational procedures including the final elements of the Tests on Completion to demonstrate that the system in its entirety can operate satisfactorily. The Service Trial is

performed by the Employer with attendance by the Contractor under the Contract in order to achieve Employer's Taking Over of the Works. During this phase, the system will be run to the published timetable but without fare-paying passengers. This phase also allows for Validation of the training procedures in a real time environment.

2) The Commissioning Team in conjunction with the Employer will develop the Service Trial Plan. Operations Department and will serve to organise and co-ordinate all on-Site activities.

3) The particular requirements for tests to be undertaken during the Service Trial are prescribed in the PS.

4) The Contractor shall provide special and general attendance to the Employer and the Engineer during the Service Trial period as required by the PS.

5) 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.

6) The Contractor shall review and comment on the Engineer's Service Trial Plan and shall identify specifications, standards, method statements, procedures, pass / fail criteria, to the Engineer for inclusion in the Plan.

7) 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.

8) 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 3 signed copies to the Engineer and may then apply for the Taking Over Certificate in accordance with the requirements of the GC.

9) The Contractor shall include a complete schedule of all Service Trial records and their current status within the Monthly Progress Report.

9.5 Activity of the Employer and the Engineer

9.5.1 The Employer and the Engineer will establish a Commissioning Team and a Site Co-ordination Team at appropriate stages of the Project. These teams will comprise representatives of all interested parties including not more than two representatives of the Contractor, subject to review by the Employer and the Engineer. In accordance with the Commissioning Plan, the Commissioning Team shall advise and plan to co-ordinate the activities of the Contractor to ensure the Employer and the Employer's requirements are met.

9.5.2 The Contractor shall participate in the activities of the Commissioning Team and Site Co-ordination Team in addition to its own testing and commissioning or as directed by the Employer or the Engineer.

9.6 Records and Reports

9.6.1 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.

9.6.2 The format of the records shall cover all mechanical and electrical 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.

9.6.3 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 licence 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.

9.6.4 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.

9.6.5 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 in accordance with Chapter 4 above.

9.6.6 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.

1) Each report of inspection and/or test shall include the appropriate details of: -

   i) the description of the item or goods subjected to the test or inspection;

   ii) if applicable, the batch from which the samples were taken for test, the size and description of samples and the method of sampling;

   iii) the place of testing;

   iv) the date and time of tests;

   v) the environmental conditions;

   vi) the technical personnel supervising or carrying out the test or inspection;

   vii) the properties tested or inspected;

   viii) the method of testing or inspection;

   ix) all relevant checklists and work sheets used during the inspection and/or test, including the readings and measurements taken during the tests; and

   x) the test results, including any calculations and graphs.

9.6.7 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.

9.6.8 The Contractor shall submit within its Monthly Progress Report a complete schedule of his commissioning records showing completion dates, target completion dates and status.

9.6.9 **Timing for Reports of Inspection and/or Test**

The Contractor shall ensure that a signed copy of each report of inspection and test is filed in his filing system within 3 (three) days of the date of inspection and test.

9.6.10 **Quality Control Register**

The Contractor shall provide and maintain at all stages of the work a quality control register or registers to identify the status of inspections, sampling and testing of the work and all certificates in accordance with Quality Control Register in Chapter 5 above.

9.6.11 **Summaries of Inspection and/or Test**

The Contractor shall submit to the Engineer for his information summaries based on each quality control register showing the type and amount of certification received and the inspection and/or testing undertaken on each element of the Works. Such summaries shall reach the Engineer's office before the 7th working day of the month. The summaries shall identify and demonstrate the compliance of such certification, inspection and/or testing with the requirements of the Contract and shall identify any item which does not conform to the requirements of the Contract.

9.7 Test Equipment and Facilities

9.7.1 The Contractor shall provide all equipment and services required for testing, including, but not limited to:

1) Laboratory test instruments.
2) Special test equipment, emulators, simulators and test software, to permit full testing of System functions and performance.
3) Other items of the System, specified elsewhere as being part of the Contractor's supply, even if not part of the Subsystem under test.
4) Consumables.

9.7.2 All test instruments shall be subject to routine inspection, testing and calibration by the Contractor.

9.7.3 Details of all test instruments shall be submitted for review by the Engineer and, if required by the Employer or the Engineer, shall be calibrated at the expense of the Contractor by an independent standards laboratory.

9.7.4 All test equipment must be capable of operating from the mains supply (230V AC 50Hz).

9.7.5 All test software shall be subject to formal quality assurance requirements stipulated elsewhere in the Specification.

9.7.6 The Contractor shall ensure that all inspection and test equipment is calibrated in accordance with the specified standards or, if such standards are not applicable to certain test and inspection equipment, with systems and programmes of calibration which have been reviewed without objection by the Engineer.

9.7.7 The Contractor shall ensure that documented evidence of instrument calibration is maintained and made available to the Employer or the Engineer on request.

9.8 Witnessing by the Employer and the Engineer

9.8.1 **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 using the form in Appendix-6 of this Specification. 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 provided that:

i) in the case of on-Site work, such notice shall be given not less than 72 hours of normal working time before the work is to be inspected and/or tested;

ii) in the case of work carried out off-Site in Delhi, such notice shall be given not less than 5 days before the work is to be inspected and/or tested; and

iii) in the case of work carried out outside Delhi, such notice shall be given not less than 14 working days before the work is to be inspected and/or tested.

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 28 days.

9.8.2 **Timing for Inspection and/or Test by the Employer and the Engineer**

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 Engineer'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.

9.8.3 **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 in accordance with clause 9.8.1(1) above.

9.9 Failures

9.9.1 The Contractor shall correct all 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.

9.9.2 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.

9.9.3 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.

9.9.4 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.

9.10 Repeat Tests

9.10.1 The Contractor shall correct and re-test every fault detected during the tests.

9.10.2 If the test results in a failure of the item under test, then the provisions of GC shall apply.

9.11 Fault Categories

9.11.1 The Engineer will allocate a category to each fault, which shall determine the future conduct of tests. Test categories shall be as defined in Table 9-1

Category	Description
0	An item recorded as a fault during testing, and subsequently considered as being a normal acceptable occurrence. Testing may continue.
1	Minor fault. An event not affecting the functionality being tested in that session. Testing may continue.
2	Repeatable fault not affecting the functionality being tested in the session. Testing may continue at the discretion of the Engineer
3	Repeatable fault affecting the functionality being tested in the session. The fault must be rectified before retest of the affected test session or sessions. Testing may proceed on other sessions if permitted by the Engineer.
4	Major fault affecting the functionality being tested in the session. The fault must be rectified before recommencing testing.
5	Non repetitive fault affecting functionality being tested in the session. The action taken will depend on the severity of the fault. Discussion is needed to establish the most appropriate course of action.
6	Documentation error or deficiency. The error will usually be amended during the test and the test will continue. The documentation shall be corrected before the tests are considered complete.
7	Deficiency in the ability of the test or test equipment to demonstrate the functionality being tested in the session. Discussion is needed to establish the most appropriate action.
8	Other fault not covered above, but requiring explanation and, in some cases, correction.

Table 9-1 Fault Categories

9.12 Fault Log

9.12.1 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.

9.12.2 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.

9.13 Hardware Failure Reports

9.13.1 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:

1) the observed symptoms;

2) the most likely cause of the failure;

3) the fault category (from Table 9-1);

4) an analysis of any stress that may have been caused to other components of the equipment being tested as a result of the failure;

5) whether the failure is a result of any component operating outside its design range; and

6) whether any design changes should be made to avoid further failures.

9.13.2 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.

9.14 Software Failure Reports

9.14.1 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.

9.14.2 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.

9.14.3 The report shall clearly show:

1) the observed symptoms;
2) the likely cause;
3) the fault category (from Table 9-1);
4) the operator input and
5) Software changes required, if any.

9.14.4 Software changes required, if any, the report shall also clearly show the following information which shall be entered when the failure has been investigated:

1) the actual cause of the failure;
2) the corrective action taken; and
3) all software modules affected.

* End of Chapter *

CHAPTER 10

10. TRAINING AND LOCALISATION

10.1 Training Requirements

10.1.1 The Contractor shall provide comprehensive training to the Employer's staff to enable all of the systems and equipment supplied, installed or modified as part of the Works to be operated and maintained in the designed manner safely and efficiently so as to achieve the maximum reliability and economy, and to meet the requirements of the Employer's programme.

10.1.2 To achieve the objective, it will be necessary to train the Employer's staff, including Employer's Training Instructors (ETI). The Contractor shall submit a Training Plan to the Engineer for review as stated in PS in accordance with clause 3.7.4 above.

10.1.3 The recommendation shall include details of training equipment necessary and appropriate to achieve the training objectives.

10.1.4 The Training Plan shall provide a structured training programme to educate and train the personnel of the Employer in all aspects of the system operation and maintenance and shall include, but not be limited to, the following:

1) Schedule of training courses;
2) Objective, syllabus, format, class size and duration of each training course;
3) Training facilities to be provided by the Employer;
4) List of training materials and documentation to be included with the training course;
5) Method of pre- and post- testing to be utilised;
6) Qualifications and experience level necessary for the trainees;
7) Instructor's qualifications; and
8) Course evaluation methods.

10.1.5 Courses offered shall be suitable for operations and maintenance staff including Workshop Repair and Overhauling staff.

10.1.6 Training shall, as a minimum, impart the following techniques to the Employer's staff of the appropriate grades:

1) all planned maintenance and overhaul of the systems and equipment supplied, installed or modified under the Contract;
2) fault finding and rectification techniques for the systems and equipment supplied, installed or modified under the Contract. These shall be developed from the Contractor's previous experience with similar equipment and also from the fault tree analysis and other analyses carried out as part of the reliability engineering studies undertaken by the Contractor;
3) normal and degraded modes of operation of the systems and equipment supplied, installed or modified under the Contract;
4) all rules, regulations, practices and procedures necessary for the safe and efficient operation of the systems and equipment supplied, installed or modified under the Contract; and
5) all contingency plans necessary to recover speedily and safely from any mishaps or emergencies that may arise with the systems and equipment supplied, installed or modified under the Contract.

10.1.7 Training shall be carried out in the medium of the English language and supplemented, if necessary, in the Hindi language.

10.2 Training Method

10.2.1 Training shall consist of classroom (theory) training, computer based interactive multi-media training (CBT), simulator training (if applicable), and practical (hands on) training.

10.2.2 The training shall take place in Delhi, unless there are prohibitive reason(s), and shall be related to Permanent Works that are to be or are being installed on the Project.

10.2.3 The training in Delhi shall be supplemented, where appropriate, by training at the Contractor's own premises and the premises of the major sub-contractors during the manufacturing and factory testing phases of the Works. Maximum use shall be made of the opportunities presented during equipment testing phases of the Contract to demonstrate and practise fault finding and diagnostic techniques.

10.2.4 To meet this need, the Contractor shall supply competent trainers/instructors to carry out training to a high degree of proficiency in areas where the Contractor has the specialised knowledge.

10.2.5 In order to ensure that satisfactory standards are met, the Employer's relevant Operations/Maintenance Department in liaison with the Training Department will monitor all training.

10.2.6 During the Defects Liability Period, when the Contractor is responsible for fault finding and repair, he shall provide practical hands on training to the Employer's maintenance staff to facilitate the successful handover of this function.

10.2.7 Where applicable, the Employer will pay all of his staff's salaries, travelling, subsistence and other related allowances.

10.3 Employer's Instructor Training

10.3.1 The Contractor shall provide training courses and training materials to train the Employer's Training Instructors (ETI) to a level of competence to allow the ETIs to subsequently train the Employer's staff in all aspects of operation and maintenance of the systems and equipment supplied, installed or modified as part of the Works.

10.3.2 For Maintenance Instructors, this shall include specific training in the use of maintenance documentation, all fault-finding guides and any special gauges, instrumentation or test equipment required in any maintenance or fault finding and analysis.

10.3.3 For Operations Instructors, this shall include training in the operation of the equipment and the various systems/sub systems under both normal and fault conditions.

10.4 Training Plant & Equipment

10.4.1 With the prior review of the Engineer, the Contractor may use the Permanent Works being erected, tested or commissioned for the training of the Employer's staff. In general, the Contractor shall not use Contract Spare parts for this purpose.

10.4.2 Training course notes shall be entirely compatible, and, where appropriate, cross-referenced to the manuals supplied by the Contractor as part of the Operation and Maintenance documentation.

10.4.3 The Contractor shall provide such written or printed matter, functional equipment, samples, models, cutaway equipment, slides, films and other instructional materials as may be necessary for training. Such equipment and material shall remain the property of the Employer and shall be sufficient both for the persons trained by the Contractor and for those to be subsequently trained by the ETI.

10.4.4 The Contractor shall provide an instructor's guide for each training course. The guide shall include the course agenda, objectives, list of resources and facilities required, detailed lesson plans, presentation notes, discussion guides, training aids and job aids, test papers, criteria and methodology for testing and assessment, and all other things that will enable the ETI to carry out repeat or refresher courses in the future.

10.4.5 All training course notes and instructor's guides shall be submitted to the Engineer for review 6 weeks prior to the commencement of the first training session of the course.

10.4.6 All training course notes and instructor's guides shall be in a form that allows for easy reproduction.

10.4.7 All training course notes and instructor's guides shall be in a standard format as set out by the Employer.

10.5 Testing and Assessment

10.5.1 The Contractor shall, at the conclusion of each training course, issue questionnaires to, and/or set practical tests for all trainees directed at determining the level of satisfaction with the course content and to assess the level of knowledge and understanding of the course content by each trainee.

10.5.2 The Contractor shall review the responses to questionnaires and the trainees' test results and forward a summary to the Engineer.

10.5.3 If the Engineer considers that the course has not achieved the required objectives, he will advise the Contractor who shall then organise and implement appropriate re-training.

10.6 Training Records

10.6.1 The Contractor shall, at the completion of each training course:

1) provide the Engineer with a consolidated training record listing the training course title, date of training, name of all trainees, training result and other relevant information; and

2) issue an appropriate certificate to each trainee who has successfully completed the course.

10.7 Localisation

10.7.1 Localisation shall be essential and shall facilitate maintenance, availability of spares, system assembly, manufacturing, software configuration &/or customisation of the system and also training of Employer's personnel as detailed in the PS.

10.7.2 The Contractor within 175 days of Commencement Date of the works shall submit a Localisation plan

∗ End of Chapter∗

CHAPTER 11

11. OPERATION AND MAINTENANCE DOCUMENTATION

11.1 General

11.1.1 The Contractor shall supply Operation and Maintenance documentation in respect of the systems and equipment supplied or installed or modified under the Contract in accordance with the requirements of the following clauses, except where expressly specified otherwise in the Contract.

11.1.2 All Operation and Maintenance Manuals produced by the Contractor shall conform to the requirements of the Employer. The Contractor shall interface with the Employer for the requisite format.

11.1.3 The Contractor shall supply all documentation, including Operation and Maintenance Manuals and “as-built” drawings, necessary for operating, maintaining, repairing and modifying the systems and equipment supplied, installed or modified under the Contract.

11.1.4 Except where otherwise stated, the Contractor shall provide one electronic copy, three bound copies and one unbound copy of all documentation. The unbound copy will be used by the Employer for reproduction purposes. All documentation shall be in the English language

11.1.5 The Operation and Maintenance Manuals shall be provided in the English language

11.1.6 The Contractor shall fully co-ordinate and cross-reference interfaces and areas associated with interconnecting equipment and systems within the Contract. The Operation and Maintenance Manuals shall fully describe the overall operation of all systems incorporating all equipment.

11.1.7 The Operation and Maintenance Manuals shall contain no irrelevant or ambiguous information and shall relate specifically to this Contract.

11.1.8 The Contractor may use manufacturer’s data and handbooks for individual items of E&M equipment that are a sub-component of the overall system, including printed circuit boards, providing they meet the intent of the Specification, and are integrated by the Contractor into the description of his equipment, and are indexed accordingly in his own general index. All such documentation shall be contained in similar binders.

11.1.9 Where a sub-assembly item is of such a nature that local repairs in New Delhi/India cannot be made and it is necessary to be returned to the manufacturer as a unit for overhaul, the specific information concerning its repair and breakdown into component parts shall be provided.

11.1.10 The document shall be collated and numbered in proper order and correspond to the contents and index tables. Nomenclature or references to any items of equipment, diagrams, figure numbers or units shall be consistent throughout the text. In order to comprehend the text, diagrams, drawings, sketches and actual photographs shall be added where necessary. All manufacturers’ literature identification codes or stamp markings shall be omitted. Precautions and warnings regarding the safety of life and equipment shall be included where applicable.

11.2 Arrangement and Format of Manuals

11.2.1 The Contractor shall arrange all documentation in accordance with the Employer requirements.

11.2.2 The Contractor shall provide documentation for all hardware and software for computer systems and other associated electronic equipment to meet the following requirements. Such documents

shall include but not be limited to:

1) manufacturers' documentation supplied as standard with the equipment;
2) hardware configuration with details of expansion capabilities and options;
3) programme loading instructions, including runtime environment configuration;
4) flow charts, data flow diagrams and state diagrams as appropriate;
5) loading and operating instructions for diagnostic programmes and specifically developed debugging tools; and

11.3 Drawings

11.3.1 The Contractor shall submit such drawings as may be required for the operation and maintenance and repair of the Permanent Works by the Employer.

11.3.2 Information contained on the drawings shall include but not be limited to:

1) arrangement drawings for all sub-systems and individual items of equipment;
2) installation and fixing drawings for all sub-systems and individual items of equipment;
3) interface drawings for all sub-systems and individual items of equipment;
4) sizes, material and finish of all fixtures and threads;
5) manufacturer's code, drawing and reference numbers;
6) wiring diagrams as per BS EN 60617, BS 3939 and BS 376 including internal wiring of sealed unit items;
7) setting dimensions and tolerances; and
8) bill of materials.

11.3.3 Where instructed by the Engineer, drawings shall be supplied with Hindi language notation in addition to English. The Engineer will supply such Hindi notation to the Contractor.

11.4 Submissions

11.4.1 The Contractor shall deliver all documentation to the Engineer by the date stated in the PS, or, if none is given, not later than six (6) months prior to the issue of the Taking Over Certificate for the Works (for the final draft version), and one (1) month prior to the issue of the Taking Over Certificate for the Works (for the final version). The delivery shall include a copy of the software and licence to operate the software to modify the manuals together with one set of CADD drawing files. The final manuals shall incorporate comments made by the Engineer on the draft manual.

11.4.2 Drawings shall be submitted to the Engineer as stated in the PS. The submission shall be in accordance with stage commissioning requirements specified in the Works Programme and shall include two Compact Discs (CD)/ Digital Versatile Disc (DVD) for each drawing.

11.4.3 Following the Engineer's review, the Contractor shall make a final submission of the complete Operation and Maintenance Manuals and as-built drawings in a form and in a quantity specified in the PS. The final submission shall be made not later than the date set by the Engineer. The type of binder used to bind the Operation and Maintenance documentation shall be of a design which will permit all changes and additions to the said documentation to be readily collated therein. The Contractor shall make such amendments to his submissions as may prove necessary during commissioning of the Permanent Works and the Defects Liability Period. Amendments found necessary during commissioning shall be completed within two months

after the issue of the Taking Over Certificate for the Works. Subsequent amendments shall be completed two months prior to the issue of the Defects Liability Certificate.

11.5 Operation and Maintenance Manuals

The Employer shall have the right to reproduce any part or the whole of any Operation and Maintenance Manual as he wishes for his O and M requirements.

∗ End of Chapter ∗

CHAPTER 12

12. SUPERVISION AND PLANNING OF MAINTENANCE

12.1 Scope

12.1.1 The Contractor shall be responsible for the supervision of maintenance of the equipment supplied under the Contract after the Employer's Taking Over of the Works or Part of the Works. The maintenance personnel shall be provided by the Employer.

12.1.2 The responsibility for the provision of supervision of maintenance shall be based on the number of man-months identified during the Tender period and incorporated into the Contract. The actual utilisation of these man-months shall be at the Employer's discretion and may be at any time up to six months after the Employer's Taking Over of the whole of the Works or the last part of the Works or the date of issuing of the Performance Certificate whichever shall be the later.

12.1.3 The scope of maintenance activities shall include all scheduled and unscheduled maintenance required including all routine inspections and service overhauls at trackside, on trains and in workshops. Maintenance work shall include fault finding following report of incidents and repair of items of equipment changed out in the course of fault rectification but excluding any Contractor's liability for work to be carried out under the requirements of the Defects Liability Period.

12.2 Maintenance Planning & Management Staff

12.2.1 The Contractor shall undertake the necessary tasks in planning the maintenance activities to ensure that the reliability of the operating railway is upheld including but not limited to:

(i) Provide recommendations in respect of philosophy and procedures for repairs of electronic systems, including PCBs, and the scale of facilities required to be set up in the Depot and Workshops for this purpose.

(ii) Preparation of detailed operational plan for the routine servicing of any equipment which requires such service. The plan shall ensure that all items in use receive maintenance within the required time cycle by suitably trained and qualified staff and under the personal safety regime appropriate to the location of the equipment being maintained.

(iii) Preparation of a detailed staffing for each and every different inspection, overhaul and repair activity. The plan shall also identify and quantify resources required by staff and groups of staff in terms of tools, tackle, protective clothing, etc.

(iv) Preparation of a detailed quality plan, covering all maintenance activities. Based on the plan it shall be possible for the maintenance organisation to obtain ISO-9001 certification.

(v) Efficient supervision of the maintenance, overhaul and repair activities of maintenance staff to ensure high quality work and productivity. This shall also include planning and supervision of ongoing training and re-training as required in the correct procedures using the training materials and courses supplied under the Contract. Where the supplied training courses are insufficient the Contractor shall develop additional training courses, manuals and materials to make good the deficiency as part of his Defects Liability responsibilities.

12.3 Supervisory Staff

12.3.1 The Contractor shall provide supervisory maintenance staff who are experts in the first and third line fault finding, maintenance and repair of the various systems supplied under the Contract:

12.3.2 The experts provided for supervision of maintenance shall have adequate qualifications and experience in the relevant discipline in the maintenance depots / workshops of existing metro type undertakings.

12.3.3 The deployment of the experts may not be continuous and they may be required to supervise the maintenance in short periods at the discretion of the Employer.

12.3.4 The experts shall be available in Delhi at short notice to supervise the Employer's staff at any time during the Normal Operating hours and by arrangement to undertake extended investigations during Non-Revenue hours.

* End of Chapter *

CHAPTER 13

13. SUPPLY OF SPARE PARTS, SPECIAL TOOLS AND TEST EQUIPMENT

13.1 Details of supply

13.1.1 The Contractor shall supply to the Employer for the Permanent Works, in accordance with the provisions of this Chapter, as part of the Works:

1) spare parts including (but not limited) sub-assemblies and those to be supplied by its subcontractors of any tier ("Spare Parts");

2) special tools, jigs, fixtures and gauges and test equipment, including those to be supplied by its subcontractors of any tier ("Special Tools and Test Equipment"),

13.1.2 The Spare Parts to be supplied by the Contractor shall consist of:

1) Contract Spares (as hereinafter defined);

2) Commissioning Spares (as hereinafter defined); and

3) Defects Liability Spares (as hereinafter defined).

13.1.3 The Contractor shall submit to the Engineer for review, in the format of a contract spares schedule, in accordance with Chapter 4 above, a list of:

1) the Spare Parts to be supplied by the Contractor as part of the Works to suit stage, categorised into individual parts or sealed units; and

2) the Special Tools and Test Equipment to be supplied by the Contractor as part of the Works to suit stage.

Such list shall be an amplification and confirmation of the list supplied with the Tender, as may have been subsequently modified during the Tender period, and shall be amended as necessary to reflect changes in design that may have occurred since the date of the Letter of Acceptance.

13.1.4 The Contractor shall use separate sets of contract spares schedules for different sub-assemblies of the main assembly / equipment.

13.1.5 The information supplied in respect of each spare part or special tool shall include, but not be limited to, the following:

1) core data - main assembly/equipment
   - i) manufacturer / brand name
   - ii) manufacturer's type/model number
   - iii) rating
   - iv) serial number if applicable
   - v) total number of the main assembly/ equipment supplied under the Contract

2) core data - sub-assembly of main assembly/equipment
   - i) manufacturer / brand name
   - ii) manufacturer's type/model number
   - iii) rating

iv) serial number, if applicable

(if items (i) to (iv) above are different from those of the main assembly/equipment)

v) total number of sub-assemblies in the main assembly/equipment supplied under the Contract

3) Individual item of main/sub assembly/equipment

i) manufacturer order number

ii) parts description - a full description of the Spare Part, including a note as to whether it is a sealed unit or whether it is an assembly or sub-assembly which can be broken-down into component parts

iii) manufacturer / brand name

iv) the manufacturer's part number (if different from the ordering number)

v) the sub-contractor's ordering part number/reference, if applicable

vi) recommended quantity

vii) unit of measurement

viii) unit price CIF to Delhi including delivery to designated location amount (quantity multiplied by unit price)

ix) total number of the Spare Part in the sub-assembly of the main assembly/equipment supplied under the Contract

x) total number of the Spare Part in all the sub-assemblies of all the main assemblies/ different equipment supplied under the Contract

The Contractor shall ensure that the ordering part numbers specified shall enable the Employer to procure the exact item in future without reference to the Contractor.

4) Primary data

i) parts catalogue number/cross reference (illustrated parts catalogues to be submitted together with the contract spares schedules to the Engineer)

ii) drawing number

5) Secondary data

i) lead times stating whether for ex-stock or for product manufactured upon receipt of order.

ii) delivery schedule(s).

iii) supplementary information:

a) special handling instruction, e.g. for fragile materials, hazardous substances, radioactive materials, etc.

b) storage requirement, e.g. overall dimensions including special packing (if any) for bulky materials, materials with limited shelf life, etc.

c) statutory requirements, e.g. licences, test certificates, etc.

d) interchangeability information

e) tailor-made product for the Contract or a standard bought-in product

f) the source of the Spare Part or Special Tool and Test Equipment, including the manufacturer’s name and address together with that of his Delhi agent

g) supplementary sheets to be used for detailed information that is important to the Employer's future procurement.

13.2 Manufacture and delivery of Spare Parts

13.2.1 The Spare Parts to be supplied under the Contract shall be manufactured at the same time as the Permanent Works. All Spare Parts shall be manufactured, works tested and inspected in accordance with the relevant quality system, suitably packed and labelled in accordance with Chapter 8 above, and delivered to the Employer by the Contractor. Before the Spare Parts are delivered to the Employer, the Contractor shall submit to the Engineer a shipment advice notifying details such as date of despatch, date of arrival, vessel name, etc. as well as a packing list to indicate the contract number, variation order number, the lot size, quantity and weight. The Spare Parts shall be consigned to the Employer and delivered in accordance with The Engineer's instructions to a programme which shall ensure that sufficient Spare Parts are delivered to facilitate normal routine maintenance of the Permanent Works by the Employer at all stages of completion. The Spare Parts shall be supplied in total not later than the date set out for stage commissioning of the system.

13.2.2 Spare Parts shall be fully interchangeable with their corresponding part. All Spare Parts shall be configured to the latest revision during the Defects Liability Period. For Spare Parts such as electronic components, lamps, fuses and other consumable and high-use items, the Contractor shall ensure that a minimum of two alternative sources of supply are available.

13.2.3 An adequate supply of Spare Parts shall be available throughout the service life of the Works, from the date of the Employer’s Taking Over of the Works. The Contractor undertakes to notify the Employer at least 6 months prior to deleting any item used in the Works from general availability.

13.2.4 For any Spare Parts that the Contractor is unable to supply throughout the service life of the Works, or where the Contractor ceases availability support of that item before the end of such service life or if the Contractor ceases trading, the Contractor undertakes to transfer the relevant intellectual property rights, design rights and technology to the Employer and the Employer shall have the full right to manufacturing drawings, schedules, software and any other information needed to manufacture the relevant item. Such rights shall give the Employer complete freedom to manufacture the item in Delhi or anywhere else world-wide. The Contractor shall also undertake to notify the Employer two years in advance of the intended cessation of spares availability of any item.

13.2.5 If any Spare Part is rendered obsolete by a design change or material change during the service life of the Works supplied under the Contract, the Contractor shall design a replacement item to match the identical mechanical and electrical interfaces as the former item.

13.2.6 If, as a result of changes in technology, any Spare Part is not completely interchangeable with the original item, or the performance of any Spare Part is different from the original item, then the Contractor shall purchase the same from the Employer, at a price agreed between the parties, such quantities of the obsolete Spare Part as the Employer may possess.

13.3 Contract Spares

13.3.1 The quantity of Spare Parts to be supplied by the Contractor to the Employer shall be determined in accordance with the formulae described in clauses 13.3.5 & 13.3.6 below, or for particular items as detailed in the PS.

13.3.2 Notwithstanding the quantities defined in the PS or by the following formulae, the quantity of Spare Parts shall be sufficient for the full operation of the Permanent Works for the first two years following the expiry of the Defects Liability Period for the works ("Contract Spares').

13.3.3 The Contractor shall supply and deliver the Contract Spares six months before completion of Defect Liability Period for each section of Works.

13.3.4 The Contractor shall submit the contract spares schedules for the Contract Spares in hard copies (including the illustrated parts catalogues) as well as soft copies to the Engineer for review.

13.3.5 The quantity of Contract Spares for the consumable and non-repairable items shall be determined in accordance with the following formula:

$$N = n*f*y*24*365$$

where:

N is the quantity of Contract Spares to be supplied for a particular item;

n is the population of the item in the Permanent Works;

f is the failure rate or rate of use of the item as applicable (failures/use per hour); and

y is the number of years of support .

Formula 13-1 – Non-repairable Spares

13.3.6 The quantity of Contract Spares for repairable item shall be determined in accordance with the following formula;

$$P_{(O-r)} = \sum^{r} c=o\ (nft)^{c} * e^{-nft})/c!$$

where:

$P_{(O-r)}$ is the probability of having stock of a Contract spare which shall be greater than 99%.

f is the failure rate (failures per hour);

n is the population of the item in the Permanent Works;

r is the number of Contract Spares to be supplied; and

t is the time for turn around of the item by the Contractor (expressed in hours).

Formula 13-2 – Repairable Spares

13.3.7 All spares quantities shall be rounded up to the nearest deliverable unit e.g. cable shall be delivered in complete drums, liquids in complete sealed containers, small parts in complete packs.

13.4 Commissioning Spares

13.4.1 In addition to the Contract Spares, the Contractor shall keep on the Site throughout the installation, erection and commissioning periods, sufficient stocks of Spare Parts 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 ("Commissioning Spares").

13.4.2 The Contractor shall supply and deliver the Commissioning Spares on or before the commencement of any Partial Acceptance Tests (PAT) or as defined in the PS.

13.4.3 The Contractor shall submit to the Engineer for review a list of all Commissioning Spares that shall be made available during the installation, erection and commissioning period.

13.4.4 The Contractor shall not be entitled to use any of the Contract Spares to replace any item in the Permanent Works during the installation, erection and commissioning periods.

13.5 Defects Liability Spares

13.5.1 In addition to the Contract Spares, the Contractor shall keep sufficient stocks of Spare Parts in an off-site location in Delhi throughout the Defects Liability Periods 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 Periods ('Defects Liability Spares").

13.5.2 The Contractor shall maintain the Defects Liability Spares on or before the commencement of the Service Trial.

13.5.3 The Contractor shall submit to the Engineer for review a list of all Defects Liability Spares that shall be maintained by the Contractor during the Defects Liability Periods.

13.5.4 The Contractor shall not be entitled to use any of the Contract Spares to replace any item in the Permanent Works during the Defects Liability Periods.

13.6 Annual Maintenance Contract (AMC) Spares (if applicable as per contract)

13.6.1 The Contractor shall keep sufficient stocks of Spare Parts in an off-site location in Delhi throughout the AMC Period to enable rapid replacement of any item in the Permanent Works found to require replacement as part of the Contractor’s obligation during the AMC Periods (“AMC spares”)

13.6.2 The Contractor shall supply and deliver the AMC Spares at least 3 months before the commencement of the AMC period.

13.6.3 The Contractor shall submit to the Employer’s Representative for review a list of all AMC spares that shall be maintained by the Contractor during the AMC Periods.

13.6.4 The Contractor shall not be entitled to use any of the Employer’s Spares to replace any item in the Permanent Works during the AMC periods.

13.7 Special Tools and Test Equipment

13.7.1 The Special Tools and Test Equipment as (together with the relevant calibration certificates, warranty certificates valid up to 3 years from date of handover) required to carry out all the functions described in the Operation and Maintenance Manual or as required by the PS shall be suitably packed and identified in accordance with Chapter 8 above, consigned to the Employer by the Contractor and delivered to the Employer in accordance with the Engineer's instructions not later than the date scheduled for stage commissioning. The extent of supply shall include protective carrying cases as may be appropriate for the storage and use of each item.

13.7.2 All Special Tools and Test Equipment shall be supplied with Operation and Maintenance Manuals, complete diagrams, schematics, assembly and connection drawings, calibration instructions and circuit diagrams/descriptions for future maintenance.

13.7.3 Where the Contractor has used the Special Tools and Test Equipment for installation and commissioning of the Permanent Works, he shall refurbish and re-calibrate each item to the satisfaction of the Engineer prior to handover to the Employer, accompanied by the Certificate of Calibration traceable to a recognised International or National standard.

13.7.4 Where any item of Special Tools and Test Equipment is provided by the Contractor, it shall be accompanied by drawings, manuals and full operating instructions 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.

13.7.5 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.

13.8 Coding and Tagging of Spare Parts and Special Tools and Test Equipment

13.8.1 All Spare Parts and Special Tools and Test Equipment to be delivered to the Employer shall each carry a tag suitably marked, bar-coded (as directed by the Engineer) and numbered.

13.8.2 The numbers on the tags shall correspond with those on the coding system developed by the Contractor for all E&M components, parts and equipment's. Also See clause 7.3.1 above.

* End of Chapter *

CHAPTER 14

14. THE WORKS AND CARE OF THE WORKS

14.1 Methods of Construction

14.1.1 The Contractor shall, as stated in the PS and in any case not less than 12 weeks before starting the construction of the Works on Site, submit to the Engineer the Construction and Installation Plan as specified in Chapter 3 above.

14.2 Temporary Works

14.2.1 Upon receiving a written application from the Contractor, the Engineer may at his absolute discretion consent to certain Temporary Works of a minor nature being exempted from the requirements of this Chapter. Such exemption shall not relieve the Contractor of any of his obligations under the Contract.

14.3 Normal Working Hours

14.3.1 Normal working hours shall be defined as the period between 0700 hours and 1900 hours on all days excluding General Holidays. Work outside normal working hours shall not be carried out unless reviewed without objection by the Engineer and unless the Contractor has obtained any necessary permission or approval from Relevant Authorities.

14.3.2 The Contractor shall inform the Engineer 24 hours, or such shorter period reviewed without objection by the Engineer, in advance of any occasion when work outside normal working hours is proposed.

14.3.3 Work in the vicinity of existing Indian Railway tracks shall only be possible in non-traffic hours. Non-traffic hours are from the time of passage of the last train at the close of traffic, to the commencement time of running of the next first train.

14.4 Drawings and Schedules

14.4.1 Detailed manufacturing drawings for the Permanent Works will not normally be required to be submitted to the Engineer for review but shall be available on the Contractor's or his sub-contractor's premises if required. The Contractor shall also maintain at the Site a comprehensive and up-to-date set of drawings properly indexed and catalogued, which shall include complete sets of detailed working and, where applicable, manufacturing drawings and shall permit free access to such drawings by the Engineer at any reasonable time.

14.5 Notification and Inspection of Works

14.5.1 The Works will be the subject of a formalised system of written applications for inspection.

14.5.2 Work that is carried out without being appropriately sanctioned by the Engineer could be classified as defective work.

14.6 Construction/Installation Restraints

14.6.1 The Contractor shall design and implement Temporary Traffic Management (TTM) in accordance with the provisions of the Enactments.

14.6.2 The Contractor shall ensure that the design, construction and performance of all Temporary Works and the design and construction of all Permanent Works shall be such that any ground movements in and around the Site will not result in settlement and/or subsidence of the ground

that will cause damage to any buildings, structures, rail, roads, footpaths, slopes or utilities.

14.6.3 The Contractor shall ensure that the method of installation of any part of the Permanent Works (prior to dewatering and excavation) minimises settlements in the adjacent ground or buildings. Dewatering of an excavation will not be permitted unless a closed perimeter of impermeable wall is complete.

14.6.4 The Contractor's design of dewatering methods shall as far as possible avoid lowering of the water table outside the excavations. The reduction in piezometric pressure shall in no case be greater than 2 metres in adjacent ground, unless the Contractor can clearly demonstrate that buildings, structures, roads, footpaths and utilities within the influence of the dewatering will not be damaged by the proposed dewatering. Pumping shall be confined within the boundaries of the excavation and the water level within the excavation shall not be lowered by more than two metres below the formation level.

14.6.5 The contractor shall ensure that any construction/installation of Works shall not endanger any public moving under/side of the site.

14.7 Protection from Water

14.7.1 Unless otherwise reviewed by the Engineer, all work shall be carried out, as near as may be practicable in the circumstances, in dry conditions, except where the work is required to be carried out in or with water or other fluids.

14.7.2 The Permanent Works, including materials for use in the Permanent Works, shall, where necessary and as near as may be practicable, be kept free of water and protected from damage due to water. Water on the Site and water entering the Site shall be disposed of by temporary drainage or pumping systems or by other methods capable of keeping the Works free of water and protected from damage due to water. Traps shall be provided by the Contractor to intercept silt and debris before water is discharged from the Site.

14.7.3 The discharge points of the temporary drainage and pumping systems shall be as those having been reviewed without objection by the Engineer. The Contractor shall make all arrangements with and obtain the necessary approvals and inspections from the Relevant Authorities for discharging water to drains, watercourses etc. The relevant work shall not start until the arrangements for disposal of the water previously reviewed without objection by the Employer's Engineer have been implemented.

14.7.4 Measures shall be taken to prevent flotation of new and existing structures.

14.8 Protection from Weather

14.8.1 Work shall not be carried out in weather conditions that may adversely affect the work unless protection by methods reviewed without objection by the Engineer is provided.

14.8.2 The Permanent Works, including materials for the Permanent Works, shall be protected by methods reviewed without objection by the Engineer from exposure to weather conditions which may adversely affect the Permanent Works.

14.9 Protection of Work

14.9.1 Finished work shall be protected by methods reviewed without objection by the Engineer from damage that could arise from the execution of adjacent work. Work shall be carried out in such a manner that work carried out by others, including Government departments, utility undertakings, Relevant Authorities and Project Contractors, is not damaged.

CHAPTER 15

15. SITE ESTABLISHMENT AND ATTENDANCE

15.1 Use of the Site

15.1.1 The Site shall not be used by the Contractor for any purpose other than for executing the Works or carrying out other work which is associated with the Works and having been reviewed without objection by the Engineer.

15.1.2 Entry to and exit from the Site shall be obtained only at the locations stated in the Contract or other locations having been reviewed without objection by the Engineer.

15.1.3 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.

15.1.4 The particular use to which the Site is put shall be submitted to the Engineer for review with the following particulars:

1) drawings showing the layout within the Site of the Engineer's and Contractor's accommodation, access roads and major facilities required early in the Contract;

15.2 Survey of the Site

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.

15.3 Fences and Signs on the Site

15.3.1 Hoardings, fences, gates and signs on and at the Site shall be maintained in a clean, stable and secure condition.

15.3.2 Project signboards stated in the Contract shall be erected not more than 28 days, or such other period reviewed without objection by the Engineer, after the Commencement Date of the Works. Other advertising signs shall not be erected on the Site unless reviewed by the Engineer.

15.3.3 The permission 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 position after Employer's Taking Over of the Works shall be repaired and repainted as instructed by the Engineer.

15.4 The Contractor's Site Accommodation

15.4.1 The Contractor's offices, sheds, stores, mess rooms, latrines and other accommodation on the Site shall be maintained in a clean, stable and secure condition. Living accommodation shall not be provided on the Site unless stated in the Contract or having been reviewed without objection by the Engineer. The Contractor's personnel shall not be allowed to live on the Site.

15.4.2 The Contractor shall provide and maintain all necessary offices, sheds, stores, mess rooms, latrines and other accommodation and remove the same from the Site on the Employer's Taking Over of the Works. These shall be to the satisfaction of the Engineer and shall be kept in a clean and sanitary condition. No structure shall be erected by the Contractor within the Site

without the written consent of the Engineer and such consent will not relieve the Contractor of the responsibility of siting temporary structures clear of the Works.

15.4.3 A copy of the plan showing the extent and position of all offices, stores, sheds, etc. shall be prepared by the Contractor and retained for inspection in the Site office.

15.4.4 The works area for Contractor's accommodation will be available to the Contractor on dates set out in the PS, Employer's Drawings or APPENDIX 8 of this Specification.

15.4.5 The Contractor shall not erect or operate canteen and kitchen facilities on the Site except with the consent of the Engineer and, where appropriate, the Relevant Authorities. Any such facilities shall, in particular but without limitation, conform to all regulations and standards to the extent required by the concerned city authorities of GNCTD.

15.4.6 It will be the Contractor's responsibility to ensure safety of the equipment and the office. For this proper arrangement of fencing and guards shall be done by the Contractor

15.5 Site Utilities and Access

15.5.1 Not used

15.5.2 If, under the Contract, the Contractor is provided with Site utilities and access by any Other Contractor under the attendance of the same or another Other Contractor, the Contractor shall ensure that all requirements in terms of use of such facilities, their upkeep and maintenance, etc. are properly observed. If the facilities provided under such attendance are insufficient for the Contractor's bona fide needs, the Contractor shall be solely responsible for providing such additional facilities he may require for the execution of the Works.

15.5.3 Access roads and parking areas shall be provided within the Site as required and shall be maintained in a clean, passable and stable condition.

15.6 Not used

15.7 Clearance of the Site

Temporary Works, which are not to remain on the Site after the Employer's Taking Over of the Works, shall be removed on the Employer's Taking Over of the Works or at such other time(s) as instructed by the Engineer. The Site shall be cleared and reinstated to the lines and levels and to the same condition as existed before the Works started except as otherwise stated in the Contract.

15.8 Attendance

15.8.1 Offices for the Employer or the Engineer

Unless otherwise stated in the Contract, the Employer or the Engineer may supply his own temporary accommodation on the Site at locations indicated in the Contract or in writing. The Contractor shall afford, provide and maintain free and unhindered access to such Employer or the Engineer's Site offices and parking areas and for the Employer or the Engineer's Site officers, contractors and workmen as may be necessary for installation, inspection, maintenance, repair and removal of the aforesaid Employer or the Engineer's Site offices and the services thereto.

15.8.2 Attendance on the Employer or the Engineer

The Contractor shall provide all necessary assistance to the Employer or the Engineer, including adequate and safe means of access to all parts of the Site to assist him in carrying out his duties and responsibilities under the Contract. Such assistance shall not include the provision of full-time attendance upon the Employer or the Engineer.

15.8.3 **Attendance on the Commissioner of Rail Safety or other inspecting authorities.**

1) The Contractor shall afford all necessary attendance upon the Commissioner of Rail Safety or other inspecting authorities Inspectorate during their inspections including adequate and safe means of access to appropriate parts of the Site.

2) The Contractor shall provide all documents necessary for inspection as are requested by the above authorities.

15.8.4 **Attendance on the Fire Services Department**

The Contractor shall afford all necessary attendance upon the Fire Services Department to enable them to carry out such tests and inspections as are required by the Delhi fire service of Practice for Inspection and Testing of Installations and Equipment and the requirements of any Other Contractors. Such attendance shall include adequate and safe means of access to all parts of the Site.

15.8.5 **Attendance on Other Contractors**

1) The Contractor shall provide general and special attendance on Other Contractors who will be carrying out the execution of electrical and mechanical and other works on the Site. Reference shall be made to the PS to determine the full extent of such attendance.

2) General attendance shall include but not be limited to providing for accepting deliveries, unloading and storing materials for the Other Contractors on the Site and allowing the Other Contractors space for their site offices, and all reasonable access and facilities for the proper execution of their work including the free use of access roads, craneage, scaffolding, ladders, stores, messrooms, sanitary and welfare facilities provided that these facilities are normally available on the Site at the time.

3) The Contractor shall allow the use of his Site services including ventilation, temporary water supply, temporary electricity supply, background lighting, pumping, watchmen, etc. by the Other Contractors. The Contractor shall ensure that his Site services referred to above shall be available for use by the Other Contractors until the commissioning of the relevant permanent installations or until the issue of the Taking Over Certificate for the Works, whichever is the later.

4) Special attendance shall include but not be limited to cutting of holes and other openings, forming chases, providing built-in sleeves, grouting in bolts, anchors, brackets, base plates, frames and the like, including making good to the disturbed work and cleaning after completion of the disturbed work.

15.8.6 **Attendance by Other Contractors**

1) Where provided for under the Contract, the Contractor shall receive attendance from Other Contractors. The Contractor shall ensure that by receiving such attendance, it does not hinder, obstruct or otherwise frustrate the Other Contractor that is providing the attendance in any way.

15.9 Contractor's Equipment

The Engineer reserves the right to order the immediate removal and replacement of any Contractor's Equipment that, in his opinion, is unsatisfactory for its purpose.

15.10 Security

15.10.1 The Contractor shall be responsible for the security of the works area for Contractor's accommodation and shall provide and maintain fencing.

15.10.2 The Contractor shall provide adequate training to its security staff to ensure that they are able to discharge their security duties properly.

15.10.3 The Contractor shall establish and maintain contingency plans to cope with emergency situations such as fire, flooding, serious damage to the Works, etc.

15.10.4 The Employer's security staff will conduct inspections and security audits on the Site and the works area for Contractor's accommodation from time to time. The Engineer will give recommendations for improvement arising from the inspections and security audits to the Contractor. However, managing the security of the Site and the works area for Contractor's accommodation remain the Contractor's responsibility.

* End of Chapter *

CHAPTER 16

16. LIAISON WITH OTHERS

16.1 Liaison with Others

16.1.1 The Contractor shall make all necessary arrangements with and obtain the necessary approvals from Government departments, utility undertakings and other duly constituted authorities for the execution of the Works.

16.1.2 The Contractor shall maintain close liaison with Other Contractors and other contractors employed by the Employer, utility undertakings or other authorities who are carrying out work on or adjacent to the Site. The Contractor shall ensure as far as possible that the progress of the Works is not adversely affected by the activities of such other entities.

16.2 Work by Other Contractors

16.2.1 The contractor shall keep note of the works which may be proceeding on various adjacent areas by others include, but is not limited to, those listed in the PS. The Engineer will keep the Contractor informed of forthcoming work by Other Contractors in the proximity of the Site.

16.2.2 The Contractor shall provide reasonable access to such contractors and any other adjacent contractors and shall where necessary liase with the appropriate contractors, utility undertakings and other duly constituted authorities on details of interdependent phasing. The Contractor shall notify the Engineer and other concerned entities at least 14 days in advance should he wish to alter these access arrangements during the course of the Works.

16.3 Interface Management

16.3.1 The Contractor shall co-ordinate with Relevant Authorities and Other Contractors in the execution of the Works.

16.3.2 The Contractor shall interface and liase with Other Contractors to ensure the effective and compatible co-ordination of all aspects of the design, installation and testing of the Works. The Engineer shall be kept fully informed at all stages of the Works.

16.3.3 The Contractor shall assign a person as the interface contact for each Other Contractor to actively manage the progress of each interface to ensure adherence to the jointly developed Interface Management Plan.

16.3.4 Throughout the design process, the Contractor shall liase with Other Contractors to develop interface designs in conjunction and co-operation with the designers of interfacing systems. Interfacing systems include, but are not limited to, those listed in the PS. These interface designs will be monitored and reviewed by the Engineer but the Contractor shall work directly with the Other interfacing Contractors to develop designs which are mutually acceptable to all parties. The Engineer will provide details of the Other Contractors as contracts are awarded.

16.3.5 The Engineer may, at his discretion, attend the Contractor's meetings with Other interfacing Contractors. The Contractor shall give the Engineer a minimum of 7 days' notice of all meetings to be held with any Other interfacing Contractors, or 14 days' notice if the meeting is to be outside New Delhi. If insufficient notice is given to the Engineer, he may require the meeting to be postponed to a later date to enable him to attend.

16.3.6 The Contractor shall provide the Engineer with two copies of the minutes of all meetings within 14 days of each meeting and also two copies of all correspondence with any Other Contractor.

16.3.7 The Contractor shall attend co-ordination/design meetings chaired by the Engineer at no greater than monthly intervals to discuss and ensure that designs are correct and that conflicts in E&M services requirements between the Contractor and Other Contractors are identified and resolved.

16.3.8 The Contractor shall co-ordinate his installation activities with the Other Contractors. The Contractor shall ensure that there is no interference to the work of the Other Contractors and shall maintain close co-ordination with Other Contractors working on or adjacent to the Works to ensure that their work can progress in a smooth and orderly manner.

16.3.9 The Contractor shall be given access to the various parts of the Site by the dates relative to the Works Programme defined in the PS as Access Dates. The PS (Chapter-4 Appendices) specify certain Key Dates by which the Contractor shall complete certain parts of his Works to enable work to be undertaken by the Other Contractors. These dates may be subject to adjustment by the Engineer in consultation with the Contractor and the Other Contractors to ensure the progress of the Project.

16.3.10 The Contractor's responsibility shall include provision of and receipt from Other Contractors or the Engineer of information required for construction of the Works and the installation of the Works and Contractor's Equipment, insofar as that requirement is specified in or can reasonably be inferred from the Contract. Where the execution of work by the Other Contractor depends upon the Contractor’s Site management or upon information to be given by the Contractor, the Contractor shall provide the Other Contractor with either the required services or the correct and accurate information required to enable the Other Contractor to meet his programme for the construction or installation of his works.

16.3.11 In the event of any disagreement as to the extent of services or information required to be exchanged between the Contractor and another Contractor, the Engineer shall determine the requirements and this determination shall be final and binding on the Contractor and the Other Contractor.

16.3.12 The Contractor shall co-ordinate his testing and commissioning activities with the Other Contractors. The Contractor shall ensure that there is no interference to the work of the Other Contractors and shall maintain close co-ordination with Other Contractors working on or adjacent to the Works to ensure that their testing and commissioning work can progress in a smooth and orderly manner.

∗ End of Chapter ∗

CHAPTER 17

17. THE SITE

17.1 Access to Site

The Contractor will be given access to the Site in accordance with conditions mentioned below.

17.2 Site Restrictions

17.2.1 The particular use to which the Site is put shall be submitted to the Engineer for review within 14 days of the Commencement Date of the Works and the Contractor shall:

1) confine his use of the areas of the Site to purposes having been reviewed without objection by the Engineer who reserves the right to extend, amend or restrict the uses to which areas of the Site will be put;

2) Follow Safety procedures so that the contractor complies with all applicable safety regulations.

3) Take care for the safety of all persons entitled to be on the Site.

4) Use reasonable efforts to keep the Site and Works clear of unnecessary obstruction so as to avoid danger to these persons.

5) where required under the Contract or for safety, provide temporary works (including roadways, footways, guards and fences) and lighting around and within the areas of the Site when or where necessary for the safety and convenience of the public or others or as directed;

6) refrain from depositing rubbish or causing nuisance or permitting nuisance to be caused and, except where reviewed without objection by the Engineer, depositing earth on or removing earth from areas of the Site;

7) on the Employer's Taking Over of the Works, or earlier if so, instructed by the Engineer, remove all Temporary Works except where permitted and reinstate the areas of the Site to the extent, standards and details indicated in the Contract or as directed by the Engineer;

8) refrain from obstructing manholes, utility access points and the like; and

9) refrain from felling trees, other than those specifically identified in the Contract to be felled, and refrain from depositing earth around the trunks of trees and protect all trees remaining on Site to the satisfaction of the Engineer.

17.2.2 Work other than that necessary for completion of the Works shall not be carried out on the Site.

17.2.3 While the Contractor is being given access to the Site, he shall provide means of distributing loads imposed by Contractor's Equipment and prevent damage to utility services.

17.2.4 The Contractor shall be responsible for keeping unauthorised persons off the Site. Except where otherwise provided, the Contractor shall not permit any person to reside on the Site.

17.2.5 Unless otherwise stated, the Contractor shall pay all rates and charges of any nature whatsoever arising out of his use of the Site and all work areas provided therein under the Contract.

17.2.6 The location and size of stockpile material within the Site, shall be submitted to the Engineer for review. All stockpiles shall be maintained at all times in a stable condition.

17.2.7 The Contractor shall not allow animals to be brought onto or kept on the Site.

17.2.8 The Contractor's attention is drawn to the Waste Disposal Regulation currently prevalent in Delhi, regarding storage, transportation and disposal of chemical waste. The Contractor's proposed methods and chemicals to be used in cleaning shall be submitted for review by the Employer's Engineer.

17.2.9 No rock crushing or screening facilities shall be set up on Site unless reviewed by the Relevant Authorities and reviewed without objection by the Engineer.

17.3 Site Services

17.3.1 Where required under the Contract, the Contractor shall provide all Site services as necessary and appropriate for the construction of the Works, which shall include, but not necessarily be limited to:

1) electricity; (see Chapter 22 below)
2) water;
3) compressed air;
4) Site communication facilities; and
5) temporary drainage and sewage disposal.

17.3.2 The Contractor shall provide such services for use solely in connection with the proper execution of the Works. The Contractor shall comply with all regulations of the utility companies and Government departments concerned. The Contractor shall provide and maintain installations associated with such services and in relation thereto and shall take all reasonable precautions to safeguard the safety and health of all persons and the security of the Site. The Engineer may demand the immediate disconnection or alteration of such installations or portions thereof he considers as being prejudicial to safety, health or security. As soon as any or all of the Contractor's installations are no longer required for the execution of the Works, they shall be entirely removed to the satisfaction of the Engineer.

17.3.3 All installations shall comply fully with all appropriate statutory requirements. Pipes, tubes, ducts or cables crossing highways, footpaths or rights of way shall be ramped over or recessed below the surface. Specific services shall comply with the following: -

1) Electricity

   The electricity supply shall comply with the requirements of Chapter 22 below.

2) Water

   An adequate supply of potable water shall be provided at the Site, including provision to the satisfaction of the Water Authority of any storage tanks so that sufficient potable water is always available for the execution of the Works.

3) Compressed Air

Except in pressurised workings, the compressed air supply for pneumatic tools and equipment shall be at a pressure of not more than 0.9MN/m^2. The Contractor shall submit for review by the Employer's Engineer details of proposed air supply for use in pressurised workings.

4) Site Communication Facilities

Where required under the Contract, the Contractor shall install efficient means of Site communications including messenger, telephone and, where appropriate, two-way radio to the satisfaction of the Engineer.

5) Temporary Drainage & Sewage Disposal

Where required under the Contract, adequate provision shall be made for the discharge or disposal from the Site of all water, surplus fluid sewage and waste products and the method of disposal shall be submitted to the Engineer for review. The Site shall be kept well drained and free from standing water. Where existing channels and gullies cannot be maintained, temporary drainage arrangements shall be provided.

17.3.4 The Employer's Engineer will instruct the Contractor as to the requirements for Site services to be connected to the Employer's Engineer's portable Site accommodation at any given location and the Contractor shall provide and maintain these services during his use of the Site.

17.4 Site Cleanliness

17.4.1 The Site shall be maintained in a clean and tidy condition. Materials, including materials required for Temporary Works shall be stored in an orderly manner. Rubbish, debris, cement bags, disused formwork and the like shall be disposed of at least once a day and the work area cleaned by flushing with water as necessary so that the Site is kept constantly clean and tidy. Notwithstanding the above, the Contractor shall place rubbish bins at strategic locations about the Site. The Contractor shall throughout the period of the Contract provide a central collection point on Site, as reviewed without objection by the Employer's Engineer, for collecting all empty cans, drums, packing and other receptacles capable of holding water. The Contractor shall ensure the regular collection and removal of such debris from the Site. After every shift of works, all work areas shall be cleaned and made tidy to the satisfaction of the Engineer.

17.4.2 The Contractor shall ensure that no earth, debris, rock or empty cable drums are deposited on public or private rights of way as a result of the Works, including any deposits arising from the movement of Contractor's Equipment. All roads, both within and external to the Site which are affected by the Works shall be kept in a clean condition by the Contractor. All haul roads shall be regularly graded and watered, as necessary to minimise dust nuisance. Where required under the Contract, the Contractor shall provide and maintain a patrol unit for the duration of the Contract. The unit shall comprise 1 foreman and 2 labourers whose services shall be allocated full-time to the unit. The main duties of the patrol unit shall include the upkeep of lighting, signage and security as well as other related duties as instructed from time to time by the Employer's Engineer.

17.4.3 The patrol unit shall be required to work outside the Contractor's normal working hours if so, required by the Employer's Engineer.

17.4.4 The Contractor shall provide all necessary protective clothing, safety equipment, hand tools, ladders, trestles, power supply, replacement equipment and the like for the exclusive use of the patrol unit.

17.5 Prevention of Mosquito Breeding

17.5.1 Measures shall be taken to prevent mosquito breeding on the Site. The measures to be taken shall include the following:

1) empty cans, oil drums, packing and other receptacles which may retain water shall be deposited at a central collection point and those not required for future use shall be removed from the Site regularly;

2) standing water shall be treated at least once every week with an environmental acceptable oil which will prevent mosquito breeding; and

3) Contractor's Equipment and other items on the Site that may retain water shall be stored, covered or treated in such a manner that water will not be retained.

17.5.2 Posters in both English and Hindi drawing attention to the dangers of permitting mosquito breeding shall be displayed prominently on the Site, to the requirement of the Enactments. These posters shall be removed on Employer's Taking Over of the Works.

17.6 Protection of the Environment

17.6.1 The Contractor shall take all reasonable steps to protect the environment (both on and off the Site) and to limit damage and nuisance to people and property resulting from pollution, noise and other results of his operations.

17.6.2 Work shall be carried out in such a manner that avoidable dust is not generated. Areas of the Site in which dust is likely to be generated shall be sprayed with water regularly. Screens, dust sheets, tarpaulins or other methods reviewed by the Engineer shall be used to prevent generation of dust. Materials, including earthworks material, from which dust may be generated when being transported to or from the Site shall be sprayed with water or covered. The location and size of material stockpiles, including excavated materials within the Site, shall be subject to review by the Employer's Engineer. All stockpiles shall be maintained at all times in a safe manner.

17.7 Engineering Conditions for Temporary Land Allocation

The Contractor shall comply with the obligations, requirements and restrictions described in the PS in respect of the Contractor's work areas if any.

17.8 Attendance by Civil Works Project Contractor

17.8.1 Where supplies of electricity, water, compressed air, temporary ventilation, temporary lighting, etc. are installed by the Civil Works Project Contractor for use during construction of the structural components of the Project, these services may be made available to the Contractor for his own use during erection, installation and testing of the Works in accordance with Chapter 22 below.

17.8.2 The Contractor shall supply the Engineer with its requirements (if any) for such services within 84 days of the Commencement Date of the Works. Upon receipt of the Contractor's declaration, the Engineer will ascertain whether any of these requirements can be satisfied by the installations installed by the Civil Works Project Contractor. The Engineer will subsequently notify the Contractor of the result of these investigations.

17.8.3 Where services are required and are not available from the Civil Works Project Contractor, the Contractor shall provide, test, maintain and subsequently remove the services.

17.8.4 Background lighting to an average level of 50 lux at the walkway level will be provided in the tunnels by the Civil Works Project Contractor. The Contractor shall provide any additional lighting he may require to facilitate his own work or for reasons of safety.

17.9 Access to the Site by Other Contractors

17.9.1 Due to the multi-discipline nature of the Project, several different parties may require access to the same portion of the Site during the construction phase for the installation, erection and testing of the Works. To facilitate the organisation and co-ordination of access and occupation requirements, including the use of Works Trains. if any, the Employer's Engineer will issue and maintain a TRIP as referred to in clause 2.13 above.

17.9.2 The TRIP will be developed from the declared requirements of all Project Contractors and others having need of access and occupancy, at the weekly Works Train Meeting. The TRIP will be subject to revision and updating to reflect changing circumstances during the progress of the Project.

17.9.3 The Contractor shall work in accordance with the arrangements prescribed by the TRIP.

17.9.4 The Contractor shall ensure that his working arrangements on the Site conform to the agreements made with the Employer's Engineer during establishment of the TRIP requirements. In particular, the Contractor shall ensure that his occupancy does not extend either physically or chronologically beyond the agreed boundaries.

17.10 Transportation of Goods

17.10.1 The Contractor shall use such routes and rights of entry to the Site as may be decided by the Employer's Engineer from time to time. Routes for very large or very heavy loads shall be discussed with the Employer's Engineer in advance of the need arising and all arrangements therefor shall be submitted for review by the Employer's Engineer.

17.10.2 In this context, the definition of the terms "very large" and "very heavy" refer to articles that cannot be transported by normal road vehicles or be handled by readily available methods. Where doubt exists, it shall be the responsibility of the Contractor to notify and discuss the nature of the load in question with the Employer's Engineer in accordance with clause 17.10.1 above.

17.10.3 The Contractor shall comply with the requirements of the Commissioner of Transport and /or the Commissioner of Police and / or any other Relevant Authority regarding any special traffic arrangements that may be necessary. The Contractor's attention is drawn to the Road Traffic (Regulation and Licensing of Vehicles) Regulations and the Road Traffic (Construction and Use) Regulations currently in use at Delhi.

17.10.4 Extraordinary traffic may be moved from docks and between areas of the Site over public highways only by police escort and on a route and at a time determined by the Relevant Authority. The Contractor shall be responsible for obtaining permission from the Relevant Authorities to move extraordinary loads and traffic and for arranging police escorts as necessary.

17.10.5 The Contractor shall make all arrangements and assume full responsibility for transportation to the Site of all Contractor's Equipment, materials and supplies needed for the proper execution of the Works.

17.10.6 While travelling to and from the Site, the Contractor shall observe all posted speed limits, traffic regulations, stop signs, etc., and adherence to the access route indicated on the Employer's

Drawings or as instructed by the Engineer. No employee of the Contractor shall trespass into any part of the Employer's premises other than the Site or the designated route of access.

17.10.7 The Contractor shall ensure that all roads and pavements, etc. leading to and around the Site are kept free from obstructions and shall not cause inconvenience or hindrance to traffic or persons either by its vehicles or by its workmen, scaffolding, plant, materials, equipment, etc.

17.10.8 The Contractor shall repair damage to existing roads, footpaths, steps, cables, sewers, live drains, etc. and shall reinstate any damage caused by the Contractor's actions.

17.11 Contractor's Own Rolling Stock

17.11.1 Where the Contractor is to provide rolling stock (either self-propelled or trailing) for use during the installation and testing of the Works, the requirements of clause 17.12 below shall apply. All the Contractor's own rolling stock shall not exceed the Construction Vehicle Load Gauge as shown in the Specification Drawings except with the Employer's Engineer's written consent.

17.11.2 The Contractor shall submit full details of any rolling stock that is to be used during the installation and testing of the Works to the Employer's Engineer for review within 90 days of the Commencement Date of the Works. Such details shall include a full description and drawings of the rolling stock, details of axle load, stopping distance, fail-safe braking system, kinematic envelope, and operating and maintenance instructions.

17.11.3 The Contractor shall maintain its own rolling stock during the installation and testing of the Works. The maintenance work shall be carried out by qualified and experienced personnel, whose qualifications have been reviewed without objection by the Employer's Engineer, in accordance with the maintenance procedures that shall have been reviewed without objection by the Employer's Engineer.

17.11.4 Prior to use, and following each maintenance examination, the Contractor's qualified engineer shall certify the Contractor's own rolling stock as fit-to-run. Thereafter, the Contractor's qualified engineer shall issue a registration tag. The expiry date, i.e. the date of the next inspection, shall be shown on the registration tag. The Contractor's own rolling stock shall not be used without a valid registration tag.

17.11.5 The Contractor shall establish a maintenance programme for his own rolling stock and shall submit the maintenance programme for review by the Employer's Engineer prior to the delivery of his own rolling stock to the Site. The Employer's Engineer will periodically inspect the Contractor's own rolling stock to ensure it is properly maintained to the standards set out in the maintenance programme.

17.11.6 If the Contractor's own rolling stock is found to be operating in an unsatisfactory or unsafe condition, it shall be immediately removed until it has been restored to an acceptable condition to the satisfaction of the Employer's Engineer.

17.12 Defined Area Working and Works Train Operations

17.12.1 When the Project under construction has been made available for track related electrical and mechanical installation works, the area will be classified as a Defined Area within which Works Trains will be operated.

17.12.2 All persons whose duties require them to work within a Defined Area must observe safety rules and procedures to be provided by the contractor and reviewed without objection by the Engineer. It shall provide procedures and guidance for the safety of all persons in the Defined Area.

17.12.3 The Contractor shall establish communicate the rules and procedures, which shall be published from time to time, to their workers and/or agents on Site, and to ensure all such rules and procedures are being observed in the course of all works and construction activities.

17.12.4 Persons working on or near tracks in a Defined Area, either by themselves or supervising a working party, must be suitably trained and qualified by the Employer or his delegates in the safety provisions of the Works Train Manual. Persons who are not qualified shall not attempt to gain access to the railway tracks unless accompanied by a qualified person.

17.12.5 When overhead lines are energised, EMUs may be running at high speed for testing. No work may be undertaken on either the Up or Down tracks when test trains are running. Procedures for gaining access to the energised track will be detailed in the Works Train Manual. The Contractor shall make requests for gaining access to the energised track at the weekly Works Train Meetings.

17.13 Work in Vicinity of Operating Tracks

17.13.1 This Paragraph shall apply to works in the vicinity of the existing Indian Railway tracks after the commencement of revenue operations and all ancillary areas which form a part of the operating system, including all depots and sidings.

17.13.2 The following words and expressions shall have the meaning hereby assigned to them in this Paragraph:

1) “Railway” means the existing rail tracks of the DMRC and Indian Railway after the commencement of revenue operations and any ancillary areas such as the depots, sidings, stations, terminus and traction power stations.

2) “Railway Representative” means a person, or persons, nominated by the Engineer to liase with the Contractor and the Engineer on matters affecting the operation of the Railway.

3) “Restriction” means speed restriction, which is a limitation of the normal permitted speed of rail traffic over a specified length of the Railway.

4) “Possession” means possession of the Railway, which is the closing of a specified length of the Railway to rail traffic.

5) “Isolation” means isolation and earthing of the electrical equipment, which is the disconnection of a section of such equipment from all sources of electricity supply and the connection of it to the Railway.

17.13.3 The Contractor shall have regard to the Specification for work within the vicinity of the Railway and shall comply strictly with the requirements as set out therein. The Contractor shall comply with any instructions given by the Employer or the Railway Representative through the Engineer with regard to planning, methods of working, safety requirements and on any other matters which may affect the operation of the Railway, and also shall comply with all rules, regulations, procedures, manuals and notices which may be published from time to time by the Employer or the Railway Representative. Provided that if a situation occurs which in the opinion of either the Contractor or the Employer or the Railway Representative may give rise to or actually constitute an emergency and either the Contractor or the Employer or the Railway Representative considers that it is not practicable to communicate through the Engineer then the Contractor and the Employer or the Railway Representative may communicate directly and the Employer or the Railway Representative may give a direct instruction to the Contractor and such instruction shall be regarded for the purposes of this Contract as an instruction from the Engineer.

17.13.4 Should the Contractor be unwilling or unable at once to conform with a direct instruction from the Employer or the Railway Representative under the provisions of the paragraph above or to carry out any remedial or other work or repair, the Employer or the Engineer may by written order to the Contractor suspend the execution of the Works or of any part thereof or authorise the carrying out of such remedial work or other work or repair by a person other than the Contractor.

17.13.5 The Contractor shall notify the Engineer as soon as possible of any direct instruction received from the Employer under the provisions of this Paragraph.

17.13.6 Where any part of the Works has to be carried out during the period of a Restriction and/or Possession and/or Isolation and the period of such Restriction and/or Possession and/or Isolation is prescribed in the Contract, the Contractor shall plan and execute that part of the Works so that such period is not exceeded and so that no further periods are required.

17.13.7 If no such period is prescribed, the Contractor shall before commencing any work holds discussions through the Engineer with the Employer who will decide whether any part of the Works is to be carried out during a period of a Restriction and/or Possession and/or Isolation and the Engineer will notify the Contractor accordingly.

17.13.8 After the method of carrying out the work has been agreed with the Employer (and taking into account any provisional arrangements which have been made) the Contractor shall in all cases other than for emergency works submit written notice of his programme of work, which shall include details of any Restriction and/or Possession and/or Isolation previously notified by the Employer as being necessary, to the Employer at least 10 (ten) weeks in advance of the proposed commencement of work on or near the Railway and shall at the same time submit a copy thereof to the Engineer.

17.13.9 Where a Restriction and/or Possession and/or Isolation is necessary, the Contractor shall initiate the necessary action to obtain the requisite approval for such Restriction and/or Possession and/or Isolation from the Employer. The Contractor shall be solely responsible for all delays caused through failure to submit the necessary application for approval, late submission of any such application or submission of inadequate information.

17.13.10 The Contractor shall so organise the execution of the work during any period of Restriction and/or Possession and/or Isolation that he will be able to give up such Restriction and/or Possession and/or Isolation at the time prescribed in the Contract or agreed by the Employer. Should the Contractor in the opinion of the Employer or the Engineer not make sufficient or adequate arrangements (including the provision of standby plant) for completing the whole or any stage of the work within the time allowed in the programme or agreed with the Employer, the Employer may in his discretion cancel the Restriction and/or Possession and/or Isolation, or the Employer may employ labour, plant and materials to assist the Contractor to finish the work or to carry out such work as is necessary, or may himself carry out such work as is necessary, to enable the Restriction and/or Possession and/or Isolation to end at the earliest possible moment.

17.13.11 A period of Restriction and/or Possession and/or Isolation cannot normally be extended. If the Contractor fails to carry out the work during any such period, then Contractor shall be required to re-apply to the Employer for a further period of Restriction and/or Possession and/or Isolation.

17.13.12 All expenses which in the opinion of the Engineer are properly incurred by the Employer as a result of the Employer making necessary arrangements to assist the Contractor or carrying out any necessary work in accordance with clause 17.13.10 above shall be a debt due from the Contractor to the Employer.

17.13.13 The Contractor shall on demand pay to the Employer any loss of revenue and additional expenditure which in the opinion of the Engineer has been incurred by the Employer by reason of the rescheduling of services by the Employer due to the Contractor obstructing the Railway or interfering with the control or signalling system or electrical equipment other than for a period for which a Restriction and/or Possession and/or Isolation has been given.

17.13.14 In the event that damage is caused by the Contractor to the Railway such that rescheduling/suspension of services by the Employer has to be made, then the Contractor shall on demand pay to the Employer any loss of revenue and additional expenditure which in the opinion of the Engineer has been incurred by the Employer in making good the damage and in rescheduling/suspending the services.

17.13.15 The Employer shall have the right to cancel or alter the date and the timing of any agreed period of Restriction and/or Possession and/or Isolation if this proves necessary for the safety or uninterrupted running of rail traffic by notice to the Contractor which shall be deemed to be an instruction issued by the Engineer, but in such an event the Engineer shall make alternative arrangements as soon as practicable.

17.13.16 Not Used.

17.14 Rodent Control

17.14.1 The Contractor shall at all times take effective measures to prevent damage by rodents to the Permanent Works and constituent parts thereof, such as cables, electronic cards, etc., during the execution of the Works and shall advise the Engineer of such measures taken accordingly.

* End of Chapter *

CHAPTER 18

18. HEALTH AND SAFETY

See Conditions of Contract on Health, Safety and Environment (May 2019)

* End of Chapter *

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CHAPTER 19

19. DAMAGE AND INTERFERENCE

19.1 Damage and Interference

19.1.1 Work shall be carried out in such a manner that, as far as is practicable, there is no damage to or interference with the following, other than such damage as is necessitated to enable the execution of the Works:

1) watercourses or drainage systems;
2) utilities;
3) structures, roads including street furniture, or other property;
4) public or private vehicular or pedestrian accesses;
5) trees, graves or burial urns; and
6) existing railways and railway systems.
7) Human Life
8) Works of Other Contractors
9) Fire Hydrants or Valves

The Contractor shall obtain prior approval of the concerned authority or party, if so required, for any work near properties under their ownership or management.

The Contractor shall inform the Engineer as soon as practicable of any item, utility or thing which is not stated in the Contract as requiring diversion, removal or relocation but which the Contractor considers as requiring diversion, removal or relocation to enable the Works to be executed. The Contractor shall not divert, remove or relocate any such item, utility or thing without such diversion, removal or relocation having been reviewed without objection by the Engineer.

19.1.2 Items which are damaged or interfered with as a result of the Works being carried out and items which are diverted, removed or relocated to enable the Works to be carried out, shall be reinstated to the same condition as existed before the Works started or to such condition as may be reviewed without objection or instructed by the Engineer.

19.1.3 The Contractor shall excavate by hand where damage may be caused by the operation of mechanical plant adjacent to any utilities.

Except with the prior approval of the Delhi Fire Services, no damage or interference with existing fire hydrants and valves shall be caused.

Prior to trench excavation, the Contractor shall carry out investigations to locate utilities by means of hand-dug inspection pits. The locations and number of inspection pits required in meeting the Contractor's obligations to establish the location of existing utilities and underground features shall be determined by the Contractor. The Contractor shall note that many existing pipes/ducts/cables may not be shown in the records kept by the utility undertakings, and may only be exposed as the excavation proceeds. The trench excavation shall be carried out by hand where there are utilities adjacent to or within the excavation works and the Contractor shall have allowed in his programme the time required for the exposing, temporary support and diversion of these recorded or unrecorded utilities. Should any pipes/ducts/cables or cover tiles be exposed, the respective utility undertaking shall be

contacted to determine if all the utilities have been located. Cover tiles and utilities shall only be removed by the utility undertakings concerned.

Where the Employer's Engineer has conducted utility and ground investigation on behalf of the Employer, the Contractor may obtain the data obtained from the investigations from the Employer's Engineer in accordance with clause 1.7.2 above and subject to the condition of clause 19.3 below.

19.2 Watercourses and Drainage Systems

19.2.1 Existing watercourses and drainage systems shall be temporarily diverted as required to enable the Works to be carried out. Particulars of the proposed diversions shall be submitted to the Employer's Engineer for review at least 14 days before the relevant work starts. Diversions shall be constructed to the satisfaction of the Employer's Engineer with such alignment and in such manner that the flow is discharged adequately and effectively without causing flooding or erosion to the adjacent area. The diversions shall be maintained while the work is being carried out and shall be reinstated, including the removal of any obstructions to flow, as soon as practicable after the work is complete.

19.2.2 Measures shall be taken to prevent excavated material, silt or debris from being deposited in existing drainage systems, watercourses or the river.

19.2.3 Under no circumstances shall foul sewage flow be diverted into existing storm-water drains and vice versa.

19.2.4 If any mechanical equipment is required for the foul sewage diversion work, the Contractor shall suggest and provide precautionary measures to mitigate against consequences of breakdown of the equipment.

19.2.5 The Contractor shall at all times ensure that all existing stream courses and drains within and adjacent to the Site are kept safe and free from any debris and any excavated materials arising from the Works. The Contractor shall ensure that chemicals and concrete agitator washings are not deposited in watercourses.

19.2.6 The Contractor shall be responsible for the Temporary Works involved in training, diverting, or conducting of open streams or drains intercepted by the Works and the Site, for the maintenance of the Temporary Works and waterways as required by the Employer's Engineer, and for reinstating these to their original courses on Employer's Taking Over of the Works, when and where in the opinion of the Employer's Engineer such action is desirable.

19.2.7 The Contractor shall take all necessary precautions to prevent water entering upon or being discharged from the Site, from entering upon the works of adjacent contractors or adjacent properties.

19.2.8 The Contractor shall provide where necessary temporary water courses, floodwalls, flood gates, ditches, drains, pumping or other means of maintaining the Works and the Site free of water.

19.3 Utilities

19.3.1 The details of existing utilities are given by the employer for information only and the accuracy of the details is not guaranteed. The Contractor shall make his own enquiries and shall carefully excavate trial holes to locate accurately the utilities indicated to him by the utility undertakings.

19.3.2 Temporary supports and protection to utilities shall be provided by methods reviewed without objection by the Employer's Engineer. Permanent supports and protection shall be provided if instructed by the Employer's Engineer.

19.3.3 The Contractor shall inform the Employer's Engineer and the utility undertakings without delay of the following:

1) damage to utilities;

2) leakage of utilities;

3) discovery of utilities not shown on any drawings; and

4) diversion, removal, repositioning or re-erection of utilities which is required to enable the execution of the Works.

19.3.4 The Contractor shall take all steps necessary to enable the utility undertakings to proceed in accordance with the programme agreed between the Contractor and the utility undertakings under clause 2.2.3 above. The Contractor shall maintain close liaison with the utility undertakings and shall inform the Employer's Engineer of any delays in works by the utility undertakings.

19.3.5 The Contractor shall keep records of existing utilities encountered on the Site and a copy provided for the Employer's Engineer. The records shall be submitted for review by the Employer's Engineer and shall contain the following details:

1) location of utility;

2) date on which utility was encountered;

3) nature and size of utility;

4) condition of utility; and

5) temporary or permanent supports provided.

19.3.6 The Contractor shall co-ordinate the activities of the utility undertakings in connection with the diversion of utility services necessary for the execution of the Works.

19.3.7 The Contractor shall set up and manage a Utilities Liaison Group for the duration of the Contract. The Group shall meet at a frequency to be as instructed by the Employer's Engineer but at least once a month, and shall discuss and resolve matters associated with utility undertakings on programming, co-ordination and action. The Contractor shall ensure that all relevant utility undertakings and the Employer's Engineer are represented at the meetings.

19.3.8 The Contractor shall inform the Employer's Engineer of the date, time and place of every meeting with utility undertakings and he shall copy all correspondence and minutes of meetings to the Employer's Engineer.

19.3.9 The programme for any section of work to be carried out by a utility undertaking shall be confirmed in writing by the Contractor to the utility undertaking no more than four weeks and no less than one week before the agreed scheduled start date for that section of Works, such confirmation to be notified to the Employer's Engineer.

19.3.10 The Contractor shall monitor the progress of utility undertakings against the agreed programmes and shall notify the Employer's Engineer of any slippage to these programmes. The agreed programmes shall mean those programmes agreed in writing by the Contractor and the various utility undertakings described in 19.3.9 above.

19.3.11 In the event of any such slippage, the Contractor shall prepare and execute a plan of action with the relevant utility undertaking to redress the slippage. Such a plan may, if necessary, include provision of Contractor's labour resources, materials and/or plant to the utility undertaking.

19.3.12 The Contractor shall ensure that the peak particle velocity and amplitude of ground movement due to temporary sheet pile driving for trench excavation or any other construction activities, as measured by a vibrograph at all water mains within or adjacent to the Site shall not exceed the values specified in Table 19-1of this GS.

Type of structure or installation	Peak particle velocity (mm/s)	Vibration amplitude (mm)
Water retaining structures Water tunnels	13	0.1
Water mains Other structures and pipes	25	0.2

Table 19-1: Peak Particle Velocity & Vibration Amplitude

19.3.13 Hand digging method shall always be employed where there are utilities adjacent to or within the trench excavation works. Portable mechanical tools may be used but shall be restricted to the breaking of the pavement surface. Due care shall be exercised to prevent damage to the underground cables, water pipes, gas pipes or other utility installations.

19.3.14 Exposed utility installations shall be adequately supported and protected from accidental damage.

19.3.15 Smoking and use of naked flames shall be prohibited if gas pipes are present, or pipes the use of which are not identified are present.

19.4 Structures, Roads and Other Property

19.4.1 The Contractor shall immediately inform the Employer's Engineer of any damage to structures, roads or other property that is not required for the execution of the Works.

19.4.2 The Contractor shall use every reasonable means to prevent any of the highways or bridges connecting with, or on the routes to, the Site from being damaged by any traffic of the Contractor or any of his sub-contractors of any tier and the Contractor shall, in particular, select routes, choose and use vehicles and restrict and distribute loads so that the moving of Temporary Works, Permanent Works and Contractor's Equipment from and to the Site shall be organised as far as reasonably possible so that no unnecessary damage or injury may be occasioned to such highways and bridges. The Contractor shall in selecting such routes take advice from and follow the instructions of the Commissioner for Transport and other Relevant Authorities of GNCTD and GOI.

19.4.3 Not Used.

19.4.4 Not Used.

19.4.5 Where the nature of the Works is such as to require the use by the Contractor of water-borne transport, the foregoing provisions of this Clause shall be construed as though "highway" includes any river or other structure related to, on or beneath a waterway, and "vehicle" includes craft, vessels or platforms and shall be read and construed accordingly.

19.4.6 If in the course of or for the purposes of the execution of the Works or any part thereof any highway or road or way shall have been damaged, broken or broken into then notwithstanding anything herein contained.

1) If the permanent reinstatement of such highway or road or way is to be carried out by the appropriate Relevant Authority or by some person other than the Contractor or any sub-contractor of any tier to him, the Contractor shall:

   i) at his own cost and independently of any requirement of or notice from the Employer's Engineer be responsible for the temporary reinstatement of such highway, road or way and the making good of any subsidence or shrinkage or other defect, imperfection, settlement or fault in the temporary reinstatement of such highway, road or way and for the execution of any necessary repair or amendment thereof from whatever cause the necessity arises until the end of the Defects Liability Period in respect of the part of the Permanent Works beneath or over such highway, road or way or until the Relevant Authority or such other person as aforesaid shall have taken possession of the highway, road or way for the purpose of carrying out permanent reinstatement, whichever is the earlier; and

   ii) indemnify and save harmless the Employer against and from any damage or injury to the Employer or claims by third parties arising out of or in consequence of any neglect or failure of the Contractor to comply with the foregoing obligations or any of them, and against and from all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto; and

2) as from the end of such Defects Liability Period or the taking of possession of such highway, road or way referred to in clause above whichever shall first happen, the Employer shall indemnify and save harmless the Contractor against and from any damage or injury to the Contractor arising out of or in consequence of or in connection with the said permanent reinstatement or any defect, imperfection or failure of or in such permanent reinstatement and against and from all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

19.4.7 Where the Relevant Authority or other person referred to in clause 19.4.6 above shall take possession of the highway, road or way as aforesaid in sections or lengths, the responsibility of the Contractor under clause 19.4.6 above shall cease in regard to any such section or length at the time at which possession thereof is so taken. But shall during the continuance of the said Defects Liability Period continue to be responsible for any section or length of which possession has not been taken and the indemnities given by the Contractor and Employer respectively under clause 19.4.6 above shall be construed and have effect accordingly.

19.5 Access

Alternative access shall be provided if interference with existing public or private vehicular or pedestrian access is necessary to enable the execution of the Works. The arrangements for the alternative access shall be as reviewed without objection by the Employer's Engineer. The permanent access shall be reinstated as soon as practicable after the work is complete and the alternative access shall be removed as soon as practicable after it is no longer required.

19.6 Trees and Other Similar Obstructions

19.6.1 Trees which are to be retained or which are not required to be removed in order to carry out the Works, shall be protected from damage at all times by methods reviewed without objection by the Engineer. Materials, including excavated materials, shall not be banked around such trees and they shall not be trimmed or cut without having been reviewed without objection by the Engineer.

19.6.2 If any trees or other obstructions are required to be removed during the execution of the Works which are not specifically required to be removed or otherwise catered for, the Contractor shall

draw the attention of the Engineer to them and shall not remove them without having received a notice of no objection from the Engineer.

19.7 Noise Control on Works Site

19.7.1 All Contractor's Equipment shall be effectively "sound-reduced" by means of silencers, mufflers, acoustics linings or shields or acoustic sheds or screens to levels prescribed in the relevant Noise Control Ordinance and measured outside the nearest occupied property or to the satisfaction of the Employer's Engineer. The Contractor shall provide details of proposed noise control measures to the Employer's Engineer for review prior to the use of any Contractor's Equipment on the Site.

19.7.2 Provided that the provisions of this Paragraph shall not be applicable in the case of emergency work necessary to save life or property or for the safety of the Works or in the case of blasting operations necessitated by urgency and reviewed by the Employer's Engineer.

19.8 Spoil Disposal

19.8.1 The Contractor shall make his own enquiries and arrangements regarding the location and the availability of spoil disposal areas and reclamation and shall pay all costs of complying with all regulations and requirements of Relevant Authorities in connection with the use of such areas. These areas are not within the control of the Employer and no claims will be entertained in respect of non-availability of a particular areas or changes in the costs of arrangements for the use thereof.

19.8.2 The Contractor shall be responsible for all necessary liaison to ensure compliance with the requirements of unproductive disposal of any surplus excavated rock or soft material which is suitable for filling

19.8.3 The Contractor shall conform to all pertinent Environmental Protection Ordinances and be liable for any breach of such Ordinances committed by himself and/or his sub-contractors during the disposal of surplus excavated material and water from the Site.

* End of Chapter *

CHAPTER 20

20. ENVIRONMENTAL PROTECTION REQUIREMENTS

See Conditions of Contract on Health, Safety and Environment (May 2019)

* End of Chapter *

CHAPTER 21

21. NOT USED

* End of Chapter *

CHAPTER 22

22. TEMPORARY ELECTRICITY SUPPLY

22.1 Not Used

22.2 Applicability

22.2.1 Where the Contractor is required to provide temporary electrical supplies, or to use, extend or expand on temporary supplies installed by others, all such activity shall be executed in accordance with clauses 22.3 to 22.20 inclusive.

22.2.2 When the Contractor makes use of temporary electrical supplies provided by other, viz. Project (Civil) Contractors, he will observe and comply with the requirements of this Chapter.

22.3 Work on Site

22.3.1 The Contractor shall nominate a representative whose name and qualifications shall be submitted in writing to the Engineer for review not later than 4 weeks before the appointment and who shall be solely responsible for ensuring the safety of all temporary electrical equipment on Site. The Contractor shall not install or operate any temporary Site electrical systems until this representative is appointed and has commenced duties.

22.3.2 The name and contact telephone number of the representative having been reviewed without objection by the 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.

22.3.3 The Contractor shall submit schematic diagrams and the details of the equipment for all temporary electrical installations, and these diagrams together with the temporary electrical equipment shall be submitted to the Engineer for review.

22.3.4 All electrical installation work on Site shall be carried out in accordance with the requirements laid down in BS 7375 and the Specification. All work shall be supervised or executed by qualified and suitably categorised electricians, who are registered as such under the Electricity Ordinance 1990/Electricity (Registration) Regulations 1990.

22.4 Electrical General

Temporary electrical Site installations and distribution systems shall be in accordance with: -

1) Indian Electrical Regulations;
2) The Power Companies' Supply Rules;
3) Electricity and its subsidiary Regulations;
4) IEE Wiring Regulations ;
5) BS 7375 Distribution of Electricity on Construction and Building Sites;
6) BS 4363 Distribution Assemblies for Electricity Supplies for Construction and Building Sites;
7) BS 6164 Safety in Tunnelling in the Construction Industry and
8) Any other applicable national standards

22.5 Materials, Appliances and Components

All materials, appliances and components used within the distribution system shall comply with BS 4363 and BS 7375 Appendix A.

22.6 Design Considerations

22.6.1 Distribution equipment utilised within the temporary electrical distribution system shall incorporate the following features: -

1) flexibility in application for repeated use;
2) suitability for transport and storage;
3) robust construction to resist moisture and damage; and
4) safety in use.

22.6.2 All cabling shall be run at high level whenever possible and firmly secured to ensure they do not present a hazard or obstruction to people and equipment.

22.6.3 The installation on Site shall allow convenient access to authorised and competent operatives to work on the apparatus contained within.

22.7 Mains Voltage

22.7.1 The Site mains voltage shall be as the Electricity Companies' Utility supplies, 415V 3-phase 4 wire system.

22.7.2 Single-phase voltage shall be as the Electricity Companies' Utility supplies, 230V supply.

22.7.3 Reduced voltages shall conform to BS 7375.

22.8 Types of Distribution Supply

22.8.1 The following voltages shall be adhered to for typical applications throughout the distribution systems:

1) fixed plant - 415V 3 phase;
2) movable plant fed by trailing cable - 415V 3 phase;
3) installations in Site buildings - 230V 1 phase;
4) fixed flood lighting - 230V 1 phase;
5) portable and hand held tools - 115V 1 phase;
6) Site lighting (other than flood lighting) - 115V 1 phase; and
7) portable hand-lamps (general use) - 115V 1 phase.

22.8.2 When the low voltage supply is energised via the Employer's transformer, any power utilised from that source shall be either 415V 3 phase or / 230V single phase as appropriate. The Contractor shall carry out any conversion that may be necessary to enable him to use power from that source.

22.9 Protection of Circuits

22.9.1 Protection shall be provided for all main and sub-circuits against excess current, residual current and earth faults. 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.

22.9.2 Discrimination between circuit breakers, circuit breakers and fuses shall be in accordance with:

1) BS 88;
2) BS EN 60898; and
3) BS 7375;
4) Any other appropriate Indian Standards.

22.10 Earthing

22.10.1 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.

22.10.2 Earthing systems shall conform to the following standards: -

1) IEE Wiring Regulations ;
2) BS Standards (7430, 7375) and
3) IEEE Standard 80 Guide for Safety in AC Substation Grounding.

22.11 Plugs, Socket Outlets and Couplers

22.11.1 Low voltage plugs, sockets and couplers shall be colour coded in accordance with BS 7375, and constructed to conform to BS EN 60309. High voltage couplers and 'T' connections shall be in accordance with BS 3905.

22.12 Cables

22.12.1 Cables shall be selected after full consideration of the conditions to which they will be exposed and the duties for which they are required. Supply cables up to 3.3KV shall be in accordance with BS 6346. The cable armouring shall be used as the earth return in conditions where the cable is continuously extended and not subject to continuous movement after installation.

22.12.2 For supplies to mobile or transportable equipment where operation of the equipment subjects the cable to flexing, the cable shall conform to one of the following standards appropriate to the duties imposed on it:

1) BS 6708 flexible cables for use at mines and quarries;
2) BS 6007 rubber insulated cables for electric power and lighting; and
3) BS 6500 insulated flexible cords and cables.

22.12.3 Where low voltage cables are to be used, reference shall be made to BS 7375. The following standards shall also be referred to particularly for underground cables: -

1) BS 6346 for armoured PVC insulated cables; and
2) BS 6708 Flexible cables for use at mines and quarries.

22.12.4 All cables which have a voltage to earth exceeding 65 V (except for supplies from welding transformers to welding electrodes) shall be of a type having a metal sheath and/or armour 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.

22.12.5 Armoured cables having an over-sheath of polyvinyl chloride (PVC) or an oil resisting and flame-retardant compound shall be used whenever there is a risk of mechanical damage occurring.

22.12.6 For resistance to the effects of sunlight, overall non-metallic covering of cables shall be black in colour.

22.12.7 Cables which have applied to them a voltage to earth exceeding 12 V but not normally exceeding 65 V shall be either one of the types as described in clause 22.12.5 above or alternatively of a type insulated and sheathed with a general purpose or heat resisting elastomer.

22.12.8 All cables that are likely to be frequently moved in normal use shall be flexible cables.

22.12.9 Flexible cables shall be in accordance with BS 6500 and BS 7375.

22.13 Lighting Installation

22.13.1 Lighting circuits shall be run separate from other sub-circuits and shall be in accordance with BS 7375 and BS 4363.

22.13.2 Voltage shall not exceed 55 V to earth except when the supply is to a fixed point and where the lighting fixture is fixed in position.

22.13.3 Luminaries shall have a degree of protection not less than IP 54. In particularly bad environments where the luminaries are exposed to excesses of dust and water, a degree of protection to IP 65 shall be employed.

22.13.4 Where the Engineer requires Site inspection of the Works, the Contractor shall upgrade the lighting level to a minimum of 200 lux by localised lighting in all areas.

22.13.5 Use of wire guards or other such devices shall provide mechanical protection of luminaries against damage by impact whenever risk of damage occurs.

22.14 Electrical Motors

22.14.1 Totally enclosed fan cooled motors to BS 4999: Part 105 shall be used.

22.14.2 Motor control and protection circuits shall be as stipulated in BS 6164. Emergency stops for machinery shall be provided.

22.15 Inspection and Testing

22.15.1 Electrical installations on Site shall be inspected and tested in accordance with the requirements of the latest IEE Wiring Regulations.

22.16 Identification

22.16.1 Identification labels of a type reviewed without objection by the Engineer shall be affixed to all electrical switches, circuit breakers and motors to specify their purpose.

22.17 Maintenance

22.17.1 Strict maintenance and regular checks of control apparatus and wiring distribution systems shall be carried out by an electrician (duly qualified to carry out the said checks) to ensure safe and efficient operation of the systems. The Contractor shall submit for review by the Engineer details of his maintenance schedule and maintenance works record.

22.18 Maintenance Record

22.18.1 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 carried out and the recommended inspection period.

22.19 Metering

22.19.1 For the purposes of the clause 22.19 above, “construction works” shall mean the Works excluding both the Contractor's on and off Site, fabrication facilities, workshops, work-yards, offices and stores.

22.19.2 The Contractor shall install a separately metered and invoiced supply or supplies of electricity for: -

1) Site fabrication facilities;
2) Site workshops and work-yards; and
3) Site offices and stores.

22.20 Power Supply for Installation

22.20.1 The system wide Contractor shall arrange for his own separate power and water supply for his installation works.

* End of Chapter *

CHAPTER 23

23. MOCK-UPS, PROTOTYPES AND SAMPLES

23.1 Requirements

23.1.1 The Contractor shall produce mock-ups, prototypes and samples as specified in the PS.

23.1.2 Samples may be subject to testing and investigation by the Employer and shall in no way be incorporated into the Permanent Works.

23.1.3 Samples shall become the property of the Employer.

23.2 Purpose

23.2.1 The mock-ups, samples and prototypes shall demonstrate the proposed design and/or design options. Any mock-ups shall increase in levels of detail and finish as the design progresses.

23.2.2 Mock-ups and prototypes may generally be produced initially with “dummy” equipment items unless otherwise specified, so long as there is sufficient detail to evaluate the operability and/or maintainability aspects of the proposed layout.

23.2.3 The mock-ups and prototypes shall be constructed at the Contractor's premises unless otherwise specified in the PS.

23.3 Review

23.3.1 The Engineer may conduct a minimum of three formal reviews initially at the place of manufacture.

23.3.2 The complete and agreed mock-ups and prototypes shall be suitable for transportation to, and display in New Delhi for final review by the Engineer and the Employer.

23.3.3 The Contractor shall transport and set up such mock-ups and prototypes at a nominated site in New Delhi. After each review, the Contractor shall incorporate the Engineer's review comments into the mock-ups and prototypes prior to the next scheduled review.

* End of Chapter *

APPENDIX 1

1. MONTHLY PROGRESS REPORT

1.1 Topics

The Monthly Progress Report required under clause 2.18 of the GS shall include as a minimum the following sections and topics:

1) Executive Summary, highlighting any matters of concern and explaining corrective action to be taken
2) Safety and Quality issues (including any necessary corrective action taken or proposed to prevent the re-occurrence of the non-conformities)
3) Programme and overall progress
4) Physical progress report (see Paragraph 2.21 of the General Specifications)
5) Achievement of Key Dates and Milestone Dates
6) Design status
7) Design and design co-ordination progress
8) Design submission and Engineer's response status (list of all design submissions showing current status to be appended)
9) Manufacturing status
10) Materials ordered / in process
11) Equipment manufactured / procured
12) Factory acceptance test status report
13) Delivery status
14) Shipping / transportation activity
15) Deliveries to DMRC (including release certificate reference)
16) Free issue items (where applicable)
17) Installation / erection on Site
18) Site surveys (where applicable)
19) Equipment installation and erection
20) Completion of remedial works / Site acceptance
21) Safety audit and safety report
22) Test and Commissioning
23) Commissioning activity
24) Planned vs. Actual Table
25) Remedial works
26) System integration tests
27) Documentation
28) Functional design
29) Operation manuals

30) Maintenance manuals

31) Training manuals

32) As-built drawings

33) Spares / special tools / test equipment

34) Training

35) Employer's Taking Over of Works (part or whole of Works)

36) Taking Over Certificate

37) Maintenance issues

38) Defects Liability

39) Contractual / Commercial

40) Payments / invoices

41) Engineer's instructions and variation orders

42) Claims / potential claims

43) Contractor's resources (details of all staff and sub-contractors engaged on the Works)

44) Progress photographs

45) Labour Compliance Records

1.2 Progress Reports

The Monthly Progress Reports shall be accompanied by:

1) the Works Programme, marked to show the status of progress to date;

2) control schedules for document submissions and issues of a repetitive or multiple nature;

3) where appropriate, exception reports to highlight any problem areas including any submissions and design information which are overdue;

4) the Key Date and Milestone report, in accordance with Paragraph 2.20 of the General Specifications;

5) The programme analysis report, in accordance with Paragraph 2.19 of the General Specifications; the physical progress (earned value) report, in accordance with Paragraph 2.21 of the General Specification;

6) "S" curve showing current status of the Contract;

7) a full list of all submissions and their current status in comparison to the Submissions Programme. Special commentary shall be provided for each item that is late to this programme giving the reasons for the delay and the proposed corrective action that will ensure that the delay does not affect any overall or stage completion dates, particularly those that interface with other parties;

8) identification and discussion of significant accomplishments, problem areas encountered, actions taken or planned to resolve actual or potential problems and conflicts, and other comments or proposals on matters (including the interfacing works) affecting or likely to affect the Works; and

9) a critical items action list which identifies outstanding problems associated with the timely completion of the Works including anticipated actions for their resolution.

1.2.1 The programmes shall show current status to provide a comparison between the Works Programme and reported progress.

1.2.2 Actual progress shall be reported for each activity in the Works Programme in the following terms:

1) the percentage of the work which is complete;

2) the remaining duration of the work;

3) the actual start date; and

4) the actual completion dates.

1.2.3 Actual progress shall reflect the physical scope of the work that has been completed and shall not be calculated based on elapsed time or hours worked. Any automatic statistical indications in the Contractor's software that is based on this principle shall be disabled.

1.2.4 Each Monthly Progress Report shall include a programme activity listing and an analysis report. All activities that have negative float shall be analysed by the Contractor to identify the impact on the achievement of Key Dates.

1.3 Copies

1.3.1 The Contractor shall submit 1 unbound coloured original and 1 unbound coloured copy, 1 coloured bound copy and one electronic scanned copy of all Monthly Progress Reports.

* End of Appendix 1

APPENDIX 2

2. CONTRACT SYSTEMS SAFETY MANAGEMENT

2.1 Safety Assurance Programme

2.1.1 The Contractor shall within 28 days of Notice to Proceed, submit his proposed Safety Assurance Programme Plan for review and acceptance by the Engineer.

2.1.2 The Safety Assurance Programme Plan shall cover design, manufacture, testing, integrated testing, and commissioning to ensure safe routing, spacing, movement and control of trains and meet the requirements as stipulated in the PS.

2.1.3 The Safety Assurance Programme Plan shall also address reliability, maintainability and availability of the system. This shall ensure the system has a high degree of reliability and minimise down time during routine and failure repair.

2.1.4 The Safety Assurance Programme Plan shall include Hazard Analysis Plan, Fire Control Plan and EMC/EMI Control Plan.

2.1.5 The Hazard Analysis Plan shall evaluate and ensure that all the hazards are identified and satisfactorily resolved.

2.1.6 The EMC/EMI Control Plan shall evaluate and ensure that the requirements for electromagnetic compatibility and interference as specified in the Employer's Requirements - Particular Specifications for all elements of the system are met.

2.1.7 The Fire Control Plan shall evaluate and ensure inter alia that the fire loadings of material proposed to be used, and the fire withstand ratings etc are as per the requirements specified in the Employer's Requirements - Particular Specifications and also are compatible with currently accepted international practices.

2.1.8 The Safety Assurance Programme Plan shall describe procedures required to perform the specific tasks necessary to achieve safety, reliability and maintainability requirements. These procedures shall be incorporated within the Contractor's Quality Assurance System, and shall be subject to review by the Engineer

2.2 Hazard Analysis Plan

2.2.1 The Contractor shall take the lead role in the interface Hazard Analysis for trackside equipment, to which the system is interfaced, provided by other contractors.

2.2.2 The Contractor shall produce the Hazard Analysis Schedule for the complete system including all interfacing systems and shall interface principally with the Rolling Stock, Signalling, Communication, Power Supply, Civil and Depot Contractor as well as any other Designated Contractors to obtain the information necessary, from their hazard analyses, to complete the analysis.

2.2.3 The Contractor shall, as part of the safety analysis, prepare analyses to identify Hazards and ensure their satisfactory resolution. The following analyses shall be prepared and submitted by the Contractor for the Engineer acceptance.

1) Preliminary hazard analysis

2) Interface hazard analysis (excluding EMI)

3) Subsystem hazard analysis

4) Operating hazard analysis including maintenance

5) Quantitative fault tree analysis

6) Failure modes effects and criticality analysis (FMECA)

2.2.4 The Hazard Analysis shall be carried out in accordance with MIL-STD-882C as the primary standard and Defence Standard 00-56, or equivalent, in areas not adequately addressed by the former standard.

2.2.5 The Contractor shall compile a list of critical and catastrophic items identified as a result of hazard analysis, FMECA or by other means.

2.2.6 All hazard resolution by procedural control shall be cross-referenced from the Critical and Catastrophic Items List to the appropriate manuals.

2.2.7 The qualitative measures of hazard severity are defined as follows:

1) Hazard Category I – Catastrophic: Operating conditions such that personnel errors, environment, design deficiencies, subsystem or component failure or procedural deficiencies may cause death or system loss. The safety target shall be based on internationally accepted standards.

2) Hazard Category II – Critical: Operating conditions such that personnel errors, environment, design deficiencies, subsystem or component failure or procedural deficiencies may cause severe injury to personnel, severe occupational illness or major system damage.

3) The safety target for the occurrence of all Category II hazards summed together shall again be based on internationally accepted standards.

4) Hazard Category III – Marginal: Operating conditions such that personnel errors, environment, design deficiencies, subsystem or component failure or procedural deficiencies, may cause minor injury to personnel, minor occupational illness or minor system damage.

5) Hazard Category IV – Negligible: Operating conditions such that personnel errors, environment, design deficiencies, subsystem or component failure or procedural deficiencies will not result in injury to personnel occupational illness or damage to the system.

2.2.8 The Contractor shall submit a Schedule for Hazard Analysis Submissions within 28 days of Commencement of Works. The Preliminary Hazard Analysis shall be submitted within 6 months of Commencement of Works. This analysis shall include a comprehensive assessment of potential equipment failure modes during normal operating and overload conditions and assess the performance of the equipment for a range of hazard conditions. The final Hazard Analysis Plan shall be submitted by the completion date of final design.

2.3 Fire Control Plan

The Contractor shall prepare a Fire Safety Design Report for review and acceptance by the Engineer. This shall be submitted within 2 months after Commencement of Works and revised and updated for the completion of the preliminary, pre-final and final design stages. Materials used in the Permanent Works of the system shall conform to fire safety requirements of BS

6853:, or the latest edition of other equivalent international standards, subject to the acceptance of the Engineer

N.B. Whichever Standard is selected for meeting the Fire Safety Criteria, then that standard shall be declared, and its requirements shall be met consistently throughout the Specification

2.4 Results

2.4.1 Source of all failure rates employed shall be indicated in the Hazard Analyses and shall be as far as possible independently established by recognised standards authorities.

2.4.2 All hazard analyses submitted to the Employer are to be standardised by the Contractor such that format and forms employed by all sub-contractors are the same.

2.4.3 The following targets shall be employed for the Fault Tree Analysis

1) No single point failure shall lead to death.

2) No combination of undetected failure and double point failures shall result in death.

3) No combination of undetected failure and single point failure shall result in major injury.

2.4.4 The procedures for Operation, Maintenance, Training and the Contractor's Quality Assurance manuals shall incorporate resolution of hazards identified from this hazard analysis. Proper cross-referencing to the hazards and resolution measures shall be provided in all these aforementioned documents.

* End of Appendix 2 *

APPENDIX 3

3. SUBMISSION FOR REVIEW REQUEST FORM

SUBMISSION FOR REVIEW REQUEST

Reference No. *(see Paragraph 4.3.2)* Date _____

Programme reference and scheduled date: _____

Submission Stage *(see Paragraph 3.5.1.1)*

Title _____

We hereby submit for review by the Engineer the documents or articles listed below:

(Introduction and list of items submitted – see Paragraph 4.3.5.2 – continue on separate sheet if necessary)

I confirm that the material submitted is in full compliance with the Contract.

Signed _____(Contractor's responsible engineer)

Engineer's Response Dated _____

The material submitted has been reviewed and the following decision is given:

"No Objection" / "No Objection Subject To" (see below) / "Rejected" (see below)

The following comments are made and a re-submission is to be made by the Contractor within 14 working days demonstrating fully how all of these are taken into account:

(Engineer's comments)

Signed _____ (Engineer)

* End of Appendix 3 *

APPENDIX 4

4. SCHEDULE OF ITEMS TO BE SUBMITTED BY CONTRACTOR

This Appendix lists the principal items to be submitted by the Contractor for review by the Engineer. This list is not exhaustive and the Contractor is reminded to satisfy itself of the requirements for all submissions whether or not they are included within this Appendix.

Article	Reference Paragraph(s)	To be submitted
Availability, Reliability and Maintainability deliverables	1.10	In accordance with RAM deliverables described in EN50126
Works Programme	2.4.1	Within 28 days of the Commencement Date of the Works
Submissions Programme	2.5.1	Within 28 days of the Commencement Date of the Works
Design, Procurement and Manufacturing Programme	2.6.1	Within 56 days of the Commencement Date of the Works
Material Control Schedule	2.6.5	As stated in the PS, or if none is given, within 56 days of the Commencement Date of the Works
Factory Testing Programme	2.6.8	Within 56 days of the Commencement Date of the Works
Installation Programme	2.7.1	Preliminary version within 56 days of the Commencement Date of the Works. Full version as stated in the PS or as directed by the Employer's Engineer
Testing & Commissioning Programme	2.8.1	Preliminary version within 56 days of the Commencement Date of the Works. Full version as stated in the PS or as directed by the Employer's Engineer
Training Programme	2.9.1, 10.7.2	Within 175 days of the Commencement Date of the Works or as stated in the PS or as directed by the Engineer
Time Chainage Programme	2.12.1	56 days before the start of Site works
Monthly Progress Report and supporting documentation	2.18.1	Within 7 days after the last day of the period to which it relates.
Physical Progress Report (baseline)	2.21	Within 28 days of the Commencement Date of the Works
Contractor's Project Plan	3.1.2	As stated in the PS, or if none is given, within 56 days of the Commencement Date of the Works
Particulars of Contractor's Representative	3.3.1(6)(iv)	28 days before the Commencement Date of the Works
Interface Management Plan	3.3.2(2)	Within 56 days of notification from the Employer's Engineer of the identity of each Project Contractor
Detailed Interface Document	3.3.2(2)(iv)(e)	Within 84 days of notification from the Employer's Engineer of the identity of each Project Contractor
EMC Management Plan	3.4.6(1)	As stated in the PS, or if none is given, within 56 days of the Commencement Date of the Works
Software Quality Assurance Plan	3.4.7	As stated in the PS, or if none is given, within 56 days of the Commencement Date of the Works
Design Plan	3.5.1	As stated in the PS, or if none is given, within 56 days of the Commencement Date of the Works
Design Verification and Validation Plan	3.5.2(1)	As stated in the PS, or if none is given, within 56 days of the Commencement Date of the Works
Contractor's Factory Testing Plan	3.5.3(1)	As stated in the PS, or if none is given, within 56 days of the Commencement Date of the Works
Test Reports	3.5.3(7)	Immediately after the completion of each inspection of Factory Testing
Procurement, Manufacturing and Delivery Plan	3.5.4(1)	As stated in the PS, or if none is given, within 56 days of the Commencement Date of the Works
Contractor's Health and Safety Documentation	3.6.2(2)	Within 28 days of the Commencement Date of the Works

Article	Reference Paragraph(s)	To be submitted
Environmental Management Plan	3.6.3(3)(iii)	28 days prior to the commencement of construction activities
Environmental Mitigation Implementation Schedule (EMIS)	3.6.3(4)(ii)	28 days prior to the commencement of construction activities.
Traffic Management Submissions	3.6.3(5)	56 days before implementation proving all relevant details and implications
Commissioning Plan	3.7.2(1)	First draft within 175 days of the Commencement Date of the Works
Installation Test Schedule	3.7.2(2)(ii)(a)	As stated in the PS or if not given, not later than 2 (two) months in advance of the Date scheduled for commencement of respective tests
Partial Acceptance Tests Plan	3.7.2(2)(ii)(b)	As stated in the PS or if not given, not later than 4 (four) months in advance of the Date scheduled for commencement of Partial Acceptance Tests
System Acceptance Tests Plan	3.7.2(2)(ii)(c)	As stated in the PS or if not given, not later than 4 (four) months in advance of the Date scheduled for commencement of System Acceptance Tests
Integration Tests & Commissioning Plan	3.7.2(2)(ii)(d)	As stated in the PS or if not given, not later than 4 (four) months in advance of the Date scheduled for commencement of Tests on Completion
Operation & Maintenance Manuals Plan	3.7.3(2)	As stated in the PS or if not given, not later than 9 (nine) months prior to the issue of the Taking Over Certificate for the Works
Training Plan	3.7.4(2)	As stated in the PS or if not given, not later than 6 (six) months prior to the issue of the Taking Over Certificate for the Works
Spare Management Plan	3.7.5(2)	As stated in the PS or if not given, not later than 6 (six) months prior to the commencement of Revenue Operations
Defects Liability Management Plans	3.7.6	As stated in the PS or if not given, not later than 6(six) months prior to the commencement of Revenue Operations
Project Document Control Procedure	4.3.2	Within 28 days of the Commencement Date of the Works
Quality Manual	5.2.3	Within 28 days of the Commencement Date of the Works
Quality System Procedures	5.2.3	Within 28 days of the Commencement Date of the Works
Details of Quality Manager	5.2.7	Within 28 days of the Commencement Date of the Works
Proposed Corrective & Preventive Action Plan	5.2.8	Within 14 days of receipt of Correction Action Request
Management Quality Plan	5.3	Within 28 days of the Commencement Date of the Works
Design Quality Plan	5.4	Within 28 days of the Commencement Date of the Works
Manufacturing Quality Plan	5.5	Within 28 of the commencement date of the works
Site Quality Plan	5.6	56 days prior to the commencement of the construction works
Reports of Quarterly Quality Audits	5.8.2	Every Three months
Quality Control Register	5.9	Before 7th working day of every month
Software Quality Assurance Plan	6.1.1	As stated in the PS, or if none given within 56 days of Notice to Proceed
Operational Safety Report (Software)	6.6	Within 28 days of completion of design and within 28 days of completion of Commissioning
Notice of Place of Manufacture	7.2.2	No less than 56 days before start of any manufacturing of goods

Article	Reference Paragraph(s)	To be submitted
Packaging Materials & Procedures	8.4.1	As stated in the PS, or if none is given, within 56 days of the Commencement Date of the Works
Latest drawings, inspection & test procedures, specifications and quality documentation for inspection of equipment	9.2.7(4)	At least 14 days prior to each First Article Inspections (FAI)
Installation Tests Reports	9.4.3(3)	Immediately after the completion of each test
Proposed Partial Acceptance Tests Records	9.4.4(7)	As stated in the PS or if not given, not later than two months in advance of the Date scheduled for commencement of tests
Partial Acceptance Tests Records	9.4.4(9)	Immediately following the successful Partial Acceptance Tests
System Acceptance Tests Records	9.4.5(8)	Immediately following the successful System Acceptance Tests
Integration Tests & Commissioning Records	9.4.6(8)	Immediately following the successful Tests on Completion of the system
Service Trial Records	9.4.7(8)	Immediately following the successful Service Trial of the system
Summaries of Inspection and/or Test	9.6.11	Before 7th day of the following month
Operation & Maintenance documentation (Final Draft Version)	11.4.1	As stated in the PS or if not given, not later than 6 months prior to the issue of the Taking Over Certificate for the Works
Operation & Maintenance documentation (Final Version)	11.4.1	As stated in the PS or if not given, not later than 1 month prior to the issue of the Taking Over Certificate for the Works
Operating & Maintenance instructions and illustrated parts list (Final Submission)	11.4.3	At a date set by the Engineer
Spare Parts List	13.1.3	As stated in the PS
Deletion of any item from Spare Parts List	13.2.3	At least 6 months prior to deleting any item used in Works from general availability.
Supply of Contract Spares	13.3.3	Prior to Six months before completion of Defects Liability Period for each section of the Works
Construction & Installation Plan	14.1.1	As stated in the PS, or if none is given, within 12 weeks before starting the construction of the Works on Site
Particular Uses of Site	17.2.1	Within 14 days of the Commencement Date of the Works
Name and qualification of safety representative for temporary site electricity	22.3.1	Not later than 4 weeks before appointment

* End of Appendix 4 *

APPENDIX 5

5. TYPICAL TYPE TEST REQUIREMENTS

5.1 Electronic and Electrical Equipment

The initial visual inspection shall be carried out to ensure that the equipment is of sound construction and, so far as can be ascertained, meets the requirements of the Specification.

5.1.1 Initial Performance Test

1) The initial performance tests shall consist of a comprehensive series of measurements of the characteristics of the equipment to demonstrate that its performance is in accordance with its functional requirements, including detailed requirements of the Specification.

2) This test shall normally be performed at an ambient temperature of 40°C +5°C while supplied at its normal voltage and frequency, if relevant.

3) This test shall extend to demonstrating compliance with any limitation on self-generated vibration or interference as stated in the Specification.

5.1.2 Modes of Testing

1) Electrical tests will generally be applied to the 'external terminals' of the item of equipment to be tested which are normally used to interface the subject equipment to other equipment or external circuits, e.g. power supply terminals, signal input/output terminals, frame (safety) earth terminals, etc. Tests may be applied in Common Mode and/or Series Mode, as described below.

2) Common mode tests generally involve testing circuits with respect to the equipment's frame earth. All accessible metal parts (intended to be connected to earth) are to be connected to the frame earth.

3) All the terminals of the circuit to be tested shall be connected together, where practicable. All terminals of circuits not involved in the test shall preferably be connected to earth.

4) For example, a common mode test on the AC power supply circuit of an item of equipment would involve connecting all the supply circuit terminals together (e.g. phase (s) and neutral) and applying the test between those connected terminals and the equipment's frame earth terminal. The terminals of all other circuits, e.g. signal input/output terminals, shall preferably be connected to earth.

5) Series mode tests generally involve testing circuit connections with respect to each other.

6) Where an item of equipment to be tested has a large number of identical interfaces circuits series mode testing may be restricted to a representative sample of those interfaces, the proportion being to the agreement of the Engineer.

7) The test is applied between terminals (other than the earth terminal) either associated with the same circuit (e.g. between power supply terminals) or associated with different circuits (e.g. between input signal terminals and output signal terminals). All terminals of circuits not involved in the test shall preferably be connected to earth.

8) For example, a series mode test on an RTU analogue input circuit would involve applying the test between the positive and negative analogue signal input terminals, preferably with all other terminals connected to earth.

9) For each item of equipment to be tested, there may be many combinations of terminals to which series mode testing could be applied. Not all combinations may be relevant or subject to the conditions against which a particular test is to be performed. However, the Contractor shall test all combinations unless specifically agreed otherwise by the Engineer.

5.2 Mechanical Tests

5.2.1 Drop Test

1) The drop test is intended to be carried out on units and sub-assemblies that are portable. It is not intended that it be carried out on complete racks of equipment.

2) Casings or dust covers, which have to be removed for servicing, shall be removed after subjecting equipment to this test to inspect for damage. The test is designed to reveal any weakness of assembly and to ensure that the component mountings are of adequate strength. It is not designed to check whether doors or windows made of glass will fracture and to this end meters, glass windows, etc., may be removed.

3) The equipment shall not be deemed to have failed the drop test if externally accessible components such as control knobs or connectors are damaged. The Engineer however reserves the right to ask for some form of guard, to prevent such damage, to be fitted at the Contractor's cost.

4) Test conditions shall be in accordance with IEC 68-2-31. Information required for paragraph 4.2 of that test:

   i) Visual inspection and function test to specification.

   ii) Assembled ready for installation.

   iii) Connectorised cables removed, casings or covers in place.

   iv) Not applicable.

   v) All.

   vi) 25mm, 6 times.

   vii) 25mm, 6 times.

   viii) Visual inspection and function test to specification.

   ix) Topple (or push over) test is not required.

5.2.2 Vibration Test

1) The vibration test is designed to reveal any parts or components of the equipment that may be prone to any resonance severe enough to cause possible damage or malfunctioning.

2) The test shall be in accordance with IEC 68-2-6 1982. Information required for Chapter 12 of that standard:

   i) Measuring Points: If four or fewer fixing points are used for the specimen, these shall also be used as checkpoints. If more than four fixing points are used then

those nearest the corners shall be used as checkpoints. The checkpoints shall be located as close as possible to the fixing points.

ii) Transverse Motion: Any transverse motion in excess of that specified in the above standard clause 4.1.2 shall be noted and recorded in the test results.

iii) Distortion: As defined in clause 3 in excess of the limits in clause 4.1.3 of the above standard shall be noted as defined in clause 4.1.3 paragraph 4 of the same standard.

iv) Derivation of Control Signal Single point.

v) Tolerances at check points shall be as clause 4.1.4.2 of the above standard. Where these cannot be achieved, the actual values shall be recorded.

vi) Monitoring of Specimen(s): The equipment shall be rigidly mounted in a jig so designed as to transmit the input vibration with minimum modification.

5.2.3 Vibration Test 1

1) Equipment intended for use with vibration isolators shall normally be tested with its isolator. When this is not possible, the equipment shall be rigidly secured to the vibrator and the input vibration levels modified to include transmissibility of the isolators.

2) Equipment under test is to be mounted in its normal operational attitude.

3) Frequency Range: See Chapter 6, Paragraph 5.5 (Equipment Requirements).

4) Vibration Amplitude: See Chapter 6, Paragraph 5.5 (Equipment Requirements).

5) Special crossover frequency: See Chapter 6, Paragraph 5.5 (Equipment Requirements).

6) Type and duration of endurance:

i) Endurance by sweeping 6 hours, i.e. 2 hours per axis

ii) Endurance at critical frequencies (as defined in the above standard clause 8.1): 1 minute at each frequency providing not more than four such frequencies exist per axis.

7) Pre-conditioning: None.

8) Initial measurements Functional test to the appropriate test procedure.

9) Axes of vibration: Three mutually perpendicular axes in turn.

10) Force Limitation: Not required.

11) Test stages to be performed in the sequence below:

i) Vibration response investigation.

ii) Endurance at fixed frequencies derived from vibration response investigation.

iii) Endurance by sweeping.

12) The equipment functionality shall be verified throughout the sweep test to the appropriate test procedure.

13) Action to be taken after vibration response investigation. If less than four critical frequencies are found in each axis, then endurance testing for the prescribed duration shall be performed at each frequency.

14) Final response test not required.

15) Predetermined frequencies shall be derived from the vibration response investigation.

16) Conditioning at the resonance frequencies of the specimen on its isolators (where fitted) shall be included.

17) Final measurements Functional test to the appropriate test procedure.

18) Any resonance liable to affect the performance or reliability of the equipment shall be reduced to an acceptable level by suitable modifications and the complete test repeated.

5.3 Environmental Tests

5.3.1 Dry Heat Test

1) The dry heat test shall be carried out on each complete piece of equipment or assembly, with all doors and covers being in place and closed as in normal operation.

2) Test conditions shall be in accordance with IEC 68-2-2. Information required for paragraph 44 of that test:

   i) Laboratory ambient.

   ii) Visual inspection.

   iii) Assembled and mounted in rack, enclosure or cabinet ready for operation or installation.

   iv) On.

   v) Maximum class temperature (see Chapter 6, Chapter 5.2, Equipment Requirements) for 16 hours.

   vi) At maximum class temperature after 16 hours, switch on and function test to specification.

   vii) Recovery at laboratory ambient.

   viii) Visual inspection and function test to specification.

   ix) None.

5.3.2 Low Temperature Test (in case applicable for Delhi ambient temperature range)

1) The low temperature test shall be carried out on each complete piece of equipment or assembly, with all doors and covers being in place and closed as in normal operation.

2) Test conditions shall be in accordance with IEC 68-2-1. Information required for paragraph 33 of that test:

   i) Laboratory ambient.

ii) Visual inspection and function test to specification.

iii) Assembled and mounted in rack, enclosure or cabinet ready for operation or installation.

iv) Off.

v) Minimum class temperature (see Chapter 6, Paragraph 5.2, Equipment Requirements) for 16 hours.

vi) At minimum class temperature after 16 hours, switch on and function test to specification.

vii) Recovery at laboratory ambient.

viii) Visual inspection and function test to specification.

ix) None.

5.3.3 Change of Temperature Test

1) If both Dry Heat and Low Temperature Tests are required (as decided by the Engineer) they may be replaced by a single test in accordance with IEC 68-2-14.

2) Information required for paragraph 2.9 of that test:

i) Assembled and mounted in rack, enclosure or cabinet ready for operation or installation.

ii) Minimum class temperature.

iii) Maximum class temperature.

iv) Per Minute.

v) One.

vi) Visual inspection.

vii) On.

viii) Hours.

ix) None.

x) Recovery at laboratory ambient.

xi) Visual inspection and function test to specification.

5.3.4 **Damp Heat Test**

1) The damp heat test shall be carried out on each complete piece of equipment or assembly, with all doors and covers being in place and closed as in normal operation.

2) Test conditions shall be in accordance with IEC 68-2-30. Information required for paragraph 10 of that test:

i) Maximum class temperature, two cycles.

ii) Visual inspection and function test to specification.

iii) Switched on, ready to use.

iv) None.

v) Variant 2.

vi) At maximum class temperature after 12 hours, function test to Specification. At 6 hours after the temperature starts to fall a further function test to specification. Tests to be repeated during second cycle.

vii) Laboratory ambient conditions.

viii) None.

ix) Visual inspection and function test to specification within 4 hours.

5.3.5 Driving Rain Test

1) The test conditions shall be in accordance with IEC 68-2-18 Method Rb 2.2.

2) Information required for paragraph 5.3.8 of that document:

i) Minutes/m2 for a minimum of 15 minutes.

ii) No preconditioning of seals.

iii) Visual inspection and function test to specification.

iv) Table V1: a = 60°. B = 60°C. duration = 10 minutes.

v) Table V2: diameter = 0.40mm. water flow = 0.10 + 0.005 dm3/min. supply pressure = 80 kPa.

3) Equipment functioning throughout the test to be verified by testing.

4) Any ingress of water shall be reported to the Engineer, the equipment shall be visually inspected and function tested to Specification.

5.4 Electrical Tests

5.4.1 Supply Variations

Measurements of equipment performance and maximum VA consumption shall be made, for supply voltage and frequency variations in all possible combinations of upper limit, normal and lower limit as detailed in the Specification. Throughout these tests, the equipment shall function in accordance with the Specification.

5.4.2 Supply Interruptions

1) The supply input to the equipment under test shall be interrupted for periods of 10 msec.

2) The tests shall be performed ten times at random for ac supplies and three times at random for dc supplies.

3) The equipment shall be capable of withstanding these interruptions of supply input without damage, interruption or resetting by the operator and shall continue to function and operate correctly in accordance with the Specification.

5.4.3 High Frequency Disturbance Test

1) The High Frequency Disturbance test is required to determine whether an item of equipment will continue to operate correctly when specified high frequency transients, representative of practical system conditions, are applied to the fully operating equipment.

2) The test to be applied is based on IEC 255-4, Appendix E.

3) This test shall be performed for all equipment required to operate in environments subject to Electrical Interference Class 2 or 3 (refer to Table 8-3) and shall be applied to the AC power supply terminals of that equipment.

4) Waveform: a damped oscillatory wave with the envelope decaying to 50% of peak value at the end of three to six cycles.

   i) Frequency: 1 MHz tolerance + 10%.

   ii) Source impedance: 200-ohm tolerance + 10%.

   iii) Repetition rate: the test wave is applied to the equipment under test at a repetition rate of 400 per second.

   iv) Duration of test: 2 s tolerance + 10% 0% (see Sub-clause E5.2.7 of IEC 255-4, Appendix E).

   v) Standard value of test voltage: Refer to Table 8-3.

   vi) Test voltage tolerance: +0 -10%.

5) The test voltage levels are the voltages at the output of the test circuit before the equipment to be tested is connected to the test circuit terminals.

6) The test leads shall not be longer than 2 m.

7) The disturbance test shall be applied to the AC supply terminals of the equipment under test in series mode (refer to Sub clause 2.1.3).

8) The tests shall be carried out with the equipment operating under nominal supply conditions.

9) The equipment shall function in accordance with the Specification throughout the test.

5.4.4 Radio Frequency Interference

1) Portable radio communication transmitters are a common source of radio frequency interference when they are operated in close proximity to equipment. A field strength of 10 V/m shall be assumed to be present in the VHF and UHF bands.

2) These field strengths are approximately those expected at a distance of 35 cm from a 5-watt hand portable radiotelephone. These fields can induce currents of the order of 100 mA into cables, screens and metalwork.

3) Other possible sources are low level radiation from adjacent equipment including fluorescent lamps and signals from powerful but more distant radio, television and radar transmitters.

4) The test to be applied is based on IEC 801-3 over a frequency range of 27 MHz to 500 MHz. The Severity Level (Chapter 5) to be applied shall be as follows:

5) The Contractor shall state to what field strength the equipment is immune, and include as an option the cost of testing to 10 V/m. The equipment functionality and performance shall not be degraded during or after the RFI test.

6) With regard to RTUs and tele-protection equipment, the command outputs shall be immune to mal-operation with the cubicle doors open when the equipment is subjected to the radiated field strengths mentioned above.

5.4.5 Electrical Stress Impulse Voltage Withstand

1) The Impulse Voltage Withstand test is designed to demonstrate that the equipment has been correctly designed to withstand, without damage, the electrical stresses to which it might be subjected in practice.

2) The test to be applied is based upon IEC 255-4, Appendix E.

3) This test shall be performed for all equipment required to operate in environments subject to Electrical Interference Class 2 or 3 (refer to Table 8-3) and shall be applied as follows:

   i) To all AC power supply input and output terminals of all equipment.

   ii) To all signal input/output, communication interface and DC power supply terminals of RTU and tele-protection equipment.

   iii) For the withstand test, the impulse voltage is a periodic transient voltage without appreciable oscillations (see IEC Publication 60, High-voltage Test Techniques).

4) Impulse waveform: This shall be the standard 1.2/50 impulse specified in IEC Publication 60 and having the following tolerances:

   i) Voltage rise time: + 30%.

   ii) Voltage falls time: + 20%.

   iii) Source impedance: 500-ohm tolerance + 10%.

   iv) Source energy: 0.5 J tolerance + 10%.

   v) Standard value of test voltage: Refer to Table 3.

   vi) Test voltage tolerance: +0 -10%.

5) The test voltage levels are the voltages at the output of the test circuit before the equipment to be tested is connected to the test circuit terminals.

6) The test leads shall not be longer than 2m.

7) Three positive and three negative impulses shall be applied at intervals of not less than 5s. Both common mode and series mode tests shall be performed (refer to Sub-clause 2.1.3).

8) After the above tests, the equipment shall be visually inspected and function tested to check compliance with the Specification.

5.4.6 Insulation Resistance (Across Isolating Barrier) Test

1) Where a barrier is used to provide isolation from external circuits, its insulation resistance shall be measured.

2) If the barrier is required to withstand high voltage stresses, then it shall be stressed at the specified voltage to demonstrate its withstand capability and a further insulation

resistance test shall be made to ascertain that it has not been significantly degraded as a result of the stress being applied.

3) The insulation of all circuits that include contacts of switches, relays or contractors for isolation functions shall be tested for insulation resistance, R1. R1 shall not be less than 20 megohm when measured at 500 V dc.

4) For switches, relays and contractors, 500 V is to be applied between:

   i) The opposite ends of each circuit with contacts in open position.

   ii) Both ends of each circuit to earth with contacts in closed position.

5) For circuits intended for connection to 100 V ac or dc and above, 2 kV RMS shall be applied for one minute and this shall be followed by a further test for insulation resistance, R2.

6) Stress to be applied between:

   i) The individual circuits of this type.

   ii) Each circuit of this type and all other circuits including earth. These other circuits can be strapped together electrically for the purpose of this test.

7) Final insulation resistance shall be such that either:

   i) R2 > 20 megohm, or

   ii) R2/R1 > 0.7.

8) For circuits intended to provide isolation against large differences in earth potential, the barrier shall, after the initial resistance measurement, be stressed to the design voltage and this shall be followed by a further insulation resistance test.

* End of Appendix 5 *

APPENDIX 6

6. REQUEST FOR INSPECTION OF WORKS FORM

DELHI METRO RAIL CORPORATION LTD.

CONTRACTOR

REQUEST FOR INSPECTION OF WORKS

To the Engineer Date

* Location) Will be ready for your inspection
) on
* Description of Works) at prior to
)
) on at hrs

* Labour and plant to be used

Signed for Contractor. Received by
for Engineer
date
time

Filled in by Engineer Mr Please arrange inspection
Mr Please check setting out
Signed

Filled in by Inspector The above work was inspected and permission was given / not given to proceed with next operation.

* The following remedial works were required

* Contractor informed verbally (to MR
by Mr on at hrs)

* Remedial works inspected and permission given to proceed with next operation on at hrs)
as supervised
by
Signed
Date Time

Verbal or written permission by the Engineer or his staff shall in no way relieve the Contractor of his responsibilities under the Contract.

* To be completed if applicable.

* End of Appendix 6 *

APPENDIX 7

7. FIRST AID REQUIREMENTS

7.1 Provisions by the Contractor

7.1.1 The Contractor shall supply portable first aid boxes maintained fully equipped at each local site offices and any work locations where 20 or more persons work at a time.

7.1.2 In each site office and work location at least one of the Contractor's employees shall be trained in first aid and should be available at all working hours for purpose of attending to emergencies.

7.1.3 The Contractor shall be responsible for making his employees aware of the location and access route to the nearest first aid base and if necessary, shall provide facilities for evacuating a workman by stretcher from the worksite.

7.1.4 The Contractor shall keep the first aid base personnel informed of the number and identity of staff working within the area of responsibility of each first aid base.

* End of Appendix 8 *

APPENDIX 8

8. WORKS AREAS

8.1 Works Areas

8.1.1 Temporary occupation of land is governed by Part VI of land acquisition Act 1894 which limits occupation to 3 years.

8.1.2 The Site is divided into a series of principal Works Areas that will be made available to the Contractor at different times and for various durations. These Works Areas are illustrated in the Drawings. In order to avoid doubt, should any discrepancies be found in the definition of the extent of these Works Areas between the Figures in this Appendix and the Drawings, the Drawings shall prevail.

8.1.3 The descriptions of the principal Works Areas given below are indicative and the Contractor shall satisfy its self as to the exact nature of the various Works Areas and the extent of works to be carried out prior to the execution of the Permanent Works or making use of the area as working space and/or for temporary site facilities.

8.1.4 In addition to these principal Works Areas, the Contractor will be required to establish secondary Works Areas at, for example, station locations. The Contractor shall submit to the Engineer proposals for the use and occupation of these secondary Works Areas, such submissions being at least sixty (60) days prior to the programmed use of the specific Works Area.

8.1.5 Prior to the Key Dates or the Works Area Handover Dates for returning any Works Area, the Contractor shall carry out the following works:

1) construct all Permanent Works within the area, to the extent defined in this Appendix, in accordance with the requirements of the Contract,

2) reinstate the area to the condition as close as possible to its condition when it was taken over,

3) form the area to the approved lines and levels and carry out such other works as may be required by the Engineer,

4) remove all rubbish, debris and other materials.

8.2 Schedule of Works Area Availability:

8.2.1 As specified in PS.

* End of Appendix 8 *

Particular Conditions (PC)

Part A - Contract Data

Conditions of Contract Conditions	Sub-Clause	Data
Employer's name and address	1.1.2.2 & 1.3	Delhi Metro Rail Corporation Limited, 5th floor, A-Wing, Metro Bhawan, Fire Brigade Lane, Barakhamba Road, New Delhi –110 001
Engineer's name and address	1.1.2.4 & 1.3	Chief Signalling &Telecomm. Engineer/P1 Delhi Metro Rail Corporation Ltd., NBCC Place, 5th Floor, South Tower, Bhishma Pitamah Marg, Pragati Vihar, New Delhi –110003
Bank's name	1.1.2.11	Japan International Cooperation Agency (JICA)
Borrower's name	1.1.2.12	The President of India
Time for Completion	1.1.3.3	36 (Thirty-Six months)
Defects Notification Period	1.1.3.7	03 (Three) years for station(s) / Depot(s),and 03 (Three) years for OCC equipment and software from the date of issue of Taking-Over Certificate for the Whole of the Works. (as per Clause 11.1 of PC Part-B)
Sections	1.1.5.6	Applicable. **Summary of Sections**are Tabulated below.
~~**Profit**~~	~~1.2~~	~~Not included~~ **Deleted**
Electronic transmission systems	1.3	Via E-mail *[Insert Contractor's name …….* *and Email Address ……..]*
Governing Law	1.4	Indian Law
Ruling language	1.4	English
Language for communications	1.4	English
Time for the Parties entering into a Contract Agreement	1.6	56 days
Time for access to, and possession of all parts of,the Site	2.1	As per Clause 2.1 of Particular Conditions in SP
Engineer's Duties and Authority	3.1(B)(ii)	Variations resulting in an increase of the Accepted Contract Amount in excess of 5% or INR 3 Crore