KOLKATA METRO RAIL CORPORATION LIMITED

EAST WEST METRO PROJECT

CONTRACT – UG – L & E (PHASE-II)

DETAILED DESIGN, DETAIL ENGINEERING, PROTOTYPE, MANUFACTURE, SUPPLY, DELIVERY AND STORAGE AT SITE, LAYING, INSTALLATION, TESTING AND COMMISSIONING (INCLUDING INTEGRATED TESTING & COMMISSIONING), TRAINING OF PERSONNEL, DEMONSTRATION OF PERFORMANCE OFSYSTEM/ EQUIPMENT & ANNUAL MAINTENANCE CONTRACT OF LIFTS & ESCALATORS (L & E) OF FOUR UNDERGROUND STATIONS OF KOLKATA METRO EAST-WEST LINE PROJECT (PHASE-II)

TENDER DOCUMENTS

VOLUME – 3 (PART II)

EMPLOYERS REQUIREMENTS

GENERAL SPECIFICATIONS

KOLKATA METRO RAIL CORPORATION LIMITED
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India

Date of issue: 29th May 2019

SUMMARY OF TENDER DOCUMENTS

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- Notice of Invitation to Tender
- Instructions to Tenderers (including Annexures)
- Form of Tender (including Appendices)

Volume 2

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- General Conditions of Contract
- Special Conditions of Contract (including Schedules)

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- **General Specification (Part-II)**

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1 REFERENCE INFORMATION

1.1 Project Description

1.1.1 The Kolkata Metro Railway will be commiossioned in two phases. Phase - I work will be Underground section between Sealdah Station and Subash Sarovar and Elevated section From Subash Sarovar to Salt Lake Sector-V station. Phase – II work will be Underground section between Sealdah and Howrah Maidan station.

PHASE-I – Underground section between Sealdah station and Subash Sarovar and Elevated section between Subash Sarovar and Salt Lake Sector-V station.

Phase - I work will include two nos. Underground Stations (Sealdah East side and Phool Bagan), Intermediate Ventilation Shafts including Fan rooms and Emergency Egress route and Auxiliary Substation at Scissor cross over between Sealdah- Phool Bagan; Entire length of Tunnels from Sealdah to Subash Sarovar; Six (6) Elevated Stations (Salt Lake Stadium, Bengal Chemical, City Centre, Central Park, Karunamoyee and Salt Lake Sector-V), 33 kV intake RSS substation at Bengal Chemical Building and Auxiliary substation at Central Park depot and the entire length of Via duct between Subash Sarovar and Salt Lake Sector-V.

PHASE-II– Underground section between Sealdah and Howrah Maidan station

Phase - II work will include Four (4) Underground Stations (Central, Mahakaran, Howrah and Howrah Maidan), Intermediate Ventilation Shafts including Fan rooms and Emergency Egress route and Auxiliary Substation and Main Receiving Sub Station Intake Switch Room at Strand Road; Entire length of Tunnels from Howrah Maidan to Sealdah.

1.1.2 This Contract comprises the Design Verification and acceptance, carry out balance detailed design to comply to employer's requirement, Detailed Engineering, manufacture, delivery and storage at site, laying, installation, testing (including integrated testing and commissioning), Demonstration of Performance of System/ Equipment and rectification of defects during the Defects Liability Period of the complete Lifts & Escalator systems within each of the UG stations, Ventilation shaft building & allied tunnels in between the UG stations. of Kolkata Metro East West Line.

1.1.3 The Rolling Stock consist of a 6-cars train with 6 passenger cars. Each passenger train car will have 4 passenger doors per side. PSGs at Elevated Stations and PSDs at Underground Stations shall be installed correspondingly to serve each passengers car doors respectively.

1.1.4 On Board Continuous Automatic Train Control System (CATC) consisting of Automatic Train Protection (ATP), Automatic Train Operation (ATO) and Automatic Train Supervision (ATS) will be provided.

1.1.5 The track gauge shall be Standard Gauge (1435mm). Main line will be provided ballastless track and depot will have ballasted/ballastless track structure.

1.1.6 A semi-open / closed system with Complex Fare Structure type Automatic Fare Collection will be provided with contactless smart fare media.

1.2 Contract Structure

1.2.1 This Contract is one of several that will together be required for the implementation and operation of Kolkata Est-west Metro System.

1.2.2 Not used.

1.2.3 The Contractor shall coordinate its interface requirements with both Civil Infrastructure and Rail Systems Contractors in consultation with the Engineer.

1.3 General Requirements

This General Specification covers the general requirements for the implementation of the Works including but not limited to requirements for the submittal of Management Plans, Project Planning and Progress Monitoring, Design submission, Installation Plan, T&C Plan etc as mentioned in this General Specification and Site Management, Draughting and CAD Standards, Coordination, Inspection, Testing and Commissioning, Spares & Tools, Training, Packaging, Storage, Shipping and Delivery and the Contractor's obligations for safety and health etc, The contractor shall submit all the plans and manuals viz design documents, installation , testing & commissioning plans and documents etc, in soft copy in CD 3 sets & 3 sets of hard copy for review to Engineer & Employer though official submittal, also 5 sets of hard copy along with 5 CD as a soft copy for the final approved documents to Engineer & Employer.

1.3.1 This General Specification shall be read in conjunction with the Conditions of Contract, the Technical Specification and the other documents forming part of the Contract.

1.3.2 The documents forming the Contract are to be taken as mutually explanatory of one another. If there is an ambiguity or discrepancy in the documents, the Employer shall issue any necessary clarifications or instructions to the Contractor. The priority of the documents shall be as defined in the Conditions of Contract.

1.4 Definitions - General

1.4.1 The definitions used in this General Specification shall be as contained in the Conditions of Contract with the following additions:

a) “Approval” means all consents, approvals. No objections, license, certificates, etc. as may be required by the Contractor to execute the Works under the Applicable Laws.

.b) “As Constructed Documentation” means As Constructed Drawings and all other documents including but not limited to software documentation that together provide a definitive record of the Works as delivered by the Contractor.

d) “As Constructed Drawings" (deemed to include “As Built Drawings” and “As Installed Drawings”) means those drawings produced by the Contractor and endorsed by it as a final record of the completed Works on site.

e) “As Manufactured Drawings” means those drawings produced by the Contractor and endorsed by it as final records of the manufacture of the Works.

f) "Baseline Programme" shall mean the proposed works programme submitted with the Tender.

g) "Integrated Station Management System" means the system installed to provide a single integrated human machine interface for the monitoring and control of all installed Building Services.

h) "Central Control Room" (CCR) means a room within the Operations Control Centre from which overall control and supervision of the Kolkata Metro East West Line., or sections of the Kolkata Metro East West Line. is executed by the Operator's control staff. It includes the front end human machine interfaces of the signalling, communications and SCADA systems and projected mimic displays.

i) "Chief Controller" means the Operator's personnel located at the system-wide overview desk in the CCR who is responsible for overseeing the monitoring and controlling of the Kolkata Metro East West Line. or sections thereof.

j) "Civil Infrastructure" means the civil, architectural and building services elements of the viaduct, stations, Depot support structures and Depot buildings.

k) "Civil Infrastructure Contractors" means contractors appointed by the Employer to execute the construction of the Civil Infrastructure.

l) "Combined Services Drawings" means drawings showing the locations, layouts and sizes of all electrical and mechanical services.

m) "Conditions of Contract" means the conditions of contract as contained in Volume II of the ternder documents.

n) "Consultants" mean the General Consultants (GC) or any other specific Consultant engaged by the Employer in connection with the Project.

o) "Contractor" means the contractor appointed by the Employer to execute the design, installation, testing and commissioning of the Platform Screen Door system for the Kolkata Metro East West Line..

p) "Controllers" means the Operator's personnel located at the Main Line and/or Depot control desks who are responsible for supervising and controlling the operation of the Kolkata Metro East West Line or section thereof.

q) "Depot" means all areas of the Depot up to and including the Depot reception/departure zone where control of trains is passed between the Depot Controller and the Line Controller.

r) "Depot Buildings" means the maintenance facilities and workshops, the Operations Control Centre, the main substation, Depot traction substation and any other buildings that are necessary within the Depot for performing maintenance services in accommodating Rail Systems equipment.

s) "Depot Controller" means the Operator's personnel located in the Depot who is responsible for monitoring and controlling the operation of train movements within the Depot.

t) "Designated Contractors" means the designated contractors as defined in the Conditions of Contract and includes PSD Contractors.

u) "Disaster Management Manual" means the document provided by Employer / Operator which provides for the procedure to be followed in the event of unforeseen contingencies affecting the Kolkata Metro East West Line or its operation.

v) "Drawings" means the drawings provided as Appendix 9 to this General Specification for the Works for the reference of the Contractor.

w) "Engineering Controller" means the Operator's personnel located at the engineering supervision desk in the CCR who is responsible for monitoring and controlling the operation of the Rail Systems Equipment and other building services equipment of the Kolkata Metro East West Line or sections thereof.

x) "Fail Safe" means a design principle which is applied into a product or functions such that in the event of a hardware failure or the effect of software error, it shall be either prohibited from assuming or maintaining an unsafe state, or enter or remain in a state known to be safe.

y) "Failure Mode" means any type of failure that a component can suffer which results in its operating parameters changing to values outside their original intended design range.

z) "Fitness For Purpose" means a condition suitable for performing the intended function to required performance levels.

aa) "General Specification" means this document together with all appendices referred to herein.

bb) "Hard Wired" means a physical electrical connection in the form of a continuous conductor.

cc) "Information Assistant" means the Operator's personnel located in the CCR who is responsible for communications with the Operator's staff and external parties during normal, degraded and emergency situations. This includes the use of telephone, radio, public address and passenger information display systems in order to undertake this task.

dd) "Initial Service" means the service to be provided to meet the forecast passenger demand for the first year of Revenue Service.

ee) NOT USED

ff) "Installation Drawings" means those drawings used by the Contractor for installation purposes which show the setting out detail and the overall integration of the Works with the work of the Civil Infrastructure Contractors and Designated Contractors.

gg) "Integrated Testing and Commissioning" means a series of tests and a period of test running to combine and integrate the various systems within the Rail System

as well as the works of the Civil Infrastructure Contractors and the Rail Systems Contractors

hh) "Key Person" means personnel nominated by the Employer to receive training from the Contractor, in accordance with the Contract, and subsequently train the basic staff of the Employer.

ii) "Kinematic Envelope" means the maximum possible displacement of the Vehicle with respect to the rails due to either static or dynamic effects, under all permissible operating conditions, including limits of build tolerance, and maintenance of both Vehicle and track, excluding curve overthrows.

jj) "Line Controller" means the Operator's personnel located at the Main Line desk in the CCR who is responsible for monitoring and controlling services on the Kolkata Metro East West Line or sections thereof.

kk) "Main Line" means all areas of the viaduct and stations and includes the Depot approach tracks up to the point where they meet the limit of the Depot as defined in the Contract Drawings.

ll) "Maintenance Management Centre" means the room provided within the Depot where fault alarms and fault reports provided by SCADA, other system terminals and/or other communications systems are recorded, entered into the Maintenance Management computerised monitoring system and maintenance responses initiated.

mm) "Manufacturing Drawings" (deemed to include "Working Drawings" and "Shop Drawings") means those drawings and such other documents as are necessary to amplify the Detailed Design for manufacturing purposes.

nn) NOT USED

oo) "Non Public Area" means the areas within a station that are normally only accessible to authorised personnel and not to the public.

pp) "Non-Vital" means a circuit, function, system or equipment whose operation is not vital for the safety of the passengers and personnel working on or about the Kolkata Metro East West Line.

qq) "Ongoing Management of Safety" means those safety related activities to be undertaken by the Kolkata Metro East West Line Operator after the commencement of Revenue Service.

rr) "Operations Control Centre" (OCC) means a facility from which the overall control and supervision of the Kolkata Metro East West Line, or sections of the Kolkata Metro East West Line is carried out including the accommodation areas for supporting equipment.

ss) "Operator" means the entity that will operate the Kolkata Metro East West Line or any section thereof as advised to the Contractor by the Employer. In the absence of such advice, the Employer shall be deemed to be the Operator for the purpose of this Contract.

tt) ”Passenger Weight” means the average weight of a passenger and shall be assumed to be 65 kg for loading calculations.

uu) “Patern Failure” means the repeated occurrences of three (3) or more relevant failures of the same replaceable part, item or equipment in same manner in identical or equivalent applications when they occur at a rate which is inconsistent with the predicted failure rate of the part, item or equipment or a single failure which is proven to be a design defect/ faillure.

vv) “Rail Systems” means any or all of Rolling Stock, Power Supply and Traction, Signalling, Communications, SCADA, AFC, Station Management Systems, Workshop Equipment depending on the context.

ww) “Relevant Authorities” means all persons and/or parties carrying out work under statutory authority including government agencies, city and regional authorities, the utility providers, Police, Fire Brigade and other emergency services.

xx) “Restricted Manual” means a train driving mode in which the train is manually driven by the Driver on a line of sight basis and the Driver has sole responsibility for ensuring that the train can be safely stopped before it encounters any obstructions on the line. A fixed speed limit will be imposed by the on-board ATP system.

yy) “Revenue Service” means the operation of the Kolkata Metro East West Line as a means of transport for fare-paying passengers.

zz) “Safety Commissioner” means the Commissioner appointed under the Applicable Laws, who shall require to be satisfied that the Kolkata Metro East West Line is safe and fit for the purpose of carrying passengers in Revenue Service.

aaa) “Safety Critical” means a circuit, function, system or equipment whose operation is vital for the safety of the passengers and/or personnel working on or about the Kolkata Metro East West Line.

bbb) ”Service Life” means the minimum period of time or equivalent kilometrage, as the case may be, from the Taking-Over Certificate during which a component, assembly, complete item of equipment or system provides acceptable technical performance, allowing for periodic maintenance.

ccc) “Software” means the intellectual creation comprising the programmes, procedures, rules and any associated documentation pertaining to the operation of a system. Software also is independent of the media used for transport.

ddd) "Structure Gauge" means the profile related to the designed normal coordinated axis of the track into which no part of any structure or fixed equipment, with the exception of the station platforms and overhead catenary system may penetrate.

eee) “Supervised Manual” means a train driving mode in which the train is manually driven by the Driver in accordance with target speeds provided by the on-board ATO system and with full ATP functionality.

fff) "System" means the complete Traction Electrification, Power Supply, Power Distribution and SCADA system including associated equipment and facilities for Kolkata Metro East West Line to be delivered by the Contractor under the Contract.

ggg) "System Operations Plan" mean the details of the operating requirements to enable the train service to be provided

hhh) "Traction Supply" means the electrical supply obtained from the overhead catenary system for Vehicle propulsion.

iii) "Train" means a consist of Vehicles or Railcars or Cars or Coaches with a driving cab at each end which shall be capable of independent bi-directional operation.

jjj) "Train Line" means a physical electrical connection in the form of a continuous conductor running the complete length of the Train which may depending on the context mean a continuous conductor for train line power from which a common electrical supply is taken, a medium for carrying data on or between Vehicles, hard wired circuits between Vehicles or any combination of these.

kkk) "Transfer Track" means a defined section within the Depot approach tracks on which Trains will pass from supervision by the Depot Controller to supervision by the Line Controller and vice versa. Automatic switching from Depot signalling mode (Restricted Manual) to Main Line operating mode (Supervised Manual / ATO) and vice versa will take also take place on the Transfer Tracks.

lll) "Projected Service" means the service to be provided to meet the forecast passenger demand for the Year 2041.

mmm) "Vehicle" or 'Railcar" or "Car" or "Coaches" means a single element of rolling stock forming part of a Train, which may comprise either a driver trailer car or a motor car or a trailer car.

nnn) "Vital" means the same as "Safety Critical".

ooo) "Works" means the entire scope of work defined in this General Specification and the associated Technical Specification forming part of the Contract.

ppp) "Works Programme" means the programme prepared by the Contractor and approved by the Engineer showing the sequence and duration of all key activities required to complete the Works.

1.5 Definitions – Loading Conditions

NOT USED

1.6 Abbreviations

1.6.1 The abbreviations used in this General Specifications are given in Appendix 8 to this General Specification.

1.7 Units

1.7.1 All documents relating to the Contract shall adopt the International System of Units (SI) as specified in ISO 1000:1992.

1.8 Drawings

1.8.1 Drawings relating to the Scope of this Contract as provided to the Contractor by the Employer are listed in Appendix 9 to this General Specification.

1.9 Overall Scope of Work for the Contract

1.9.1 The Works are defined in the Volume 3 (Part I) including associated subsystems, equipment and facilities which shall be construed to include design, procurement, manufacture, supply, delivery, construction, installation, testing and commissioning, Integrated System Testing and Trial Running all as required for the Contractor to fulfill its obligations under the Contract.

1.9.2 The Works shall include the provision of associated spares (including consumable spares, tools, testing and diagnostics equipment, jigs and fixtures etc. as necessary to support the maintenance and repair of the equipment comprising the Works. Tenderers to note that on demonstration of the performance of the system and equipment and Taking over by the Employer, the DLP for 2 years commences.The DLP shall include complete maintainance also.

1.9.3 The Works shall include the preparation and submission of operation manuals, training of the Employer's Key Personnel in the use of equipment, coordination with the Employer and technical contribution to the Employer in relation to the development of detailed operations plans and procedures, rules and other services required for the Operator to execute and manage the operation of the Lift & Escalator System within the overall context of the operation of the Kolkata Metro East West Line.

1.9.4 The Works shall include the preparation and submission of input to an overall maintenance management system including maintenance schedules, rules, regulations, manuals, procedures, training of the Employer's / Operator's Key Personnel and other services required to execute and manage the maintenance and repair of the equipment comprising the Works within the overall context of the maintenance of the Kolkata Metro East West Line.

1.9.5 The Works shall include all necessary assistance and timely provision of information to permit the Employer to carry out the role of system interfacing coordination for the whole of the Rail Systems including but not limited to Rolling Stock, Signalling and Train Control, radio and telecommunications equipment and passenger information display equipment on board the Rolling Stock, Depot and workshop, permanent way, Third rail equipment, traction power supply and civil works.

1.9.6 The Works shall include system assurance in accordance with the requirements of the System Assurance Document forming part of the Contract, as applicable to the Systems as defined in the Volume -3 including safety, reliability, maintainability and availability studies and input to hazard analysis and risk assessments which cover all aspects of design, operation and maintenance where the criteria for safety is that the risk from hazards shall be reduced to as low a level as reasonably practicable.

1.9.7 The Works shall include due consideration to the ergonomic aspects of all elements of the Equipment comprising the Works where there is a significant Human-machine interface in accordance with the System Assurance document (Vol-3 part II).

1.9.8 The Contractor shall provide copies of all installed software (including the necessary As Built Documentation) together with their software source code and supporting information sufficient for the Employer to be able to reinstall all software and make amendments to the application software, if required. If the Contractor is unable to furnish the same to the Employer, it shall provide sufficient grounds for the same which shold be acceptable to the Engineer. If the Engineer accepts the grounds, the Contractor shall deposit the source codes along with supporting information, in an escrow account which shall be managed by an escrow agent. The rights and obligations of each Party and the escrow agreement shall be finalised before finalising the Contract.

1.9.9 The Contractor agrees and acknowledges that at any time within five (5) years after the completion of the Works, if the Contractor modifies and/ or upgrades any software forming part of the Permanent Works, either on its own or on order of any third party, which modification and/ or upgradation is also applicable (wholly or partly) to the Works, the Contractor shall provide the benefit of such modified and/or updated version of such software to the Employer, without any additional cost to the Employer.

1.9.10 In case of any modification and/ or upgradation to any software forming part of the Permanent Works at any time after a period of five (5) years from the date of completion of the Works or any modification and/ or upgradation to any hardware forming part of the Permanent Works at any time after completion of the Works, the Contractor shall immediately inform the Employer of such modification and/or upgradation. If the Employer requires, the Contractor shall provide such modified and/or upgraded software and/or hardware to the Employer at the costs to be mutually agreed between the Parties.

1.10 Particular Scope of Work for the Systems as defined in the Volume 3 Part I

1.10.1 The Works shall incorporate the detailed performance requirements and design criteria for the Systems as defined in the Technical Specification .

1.10.2 The Contractor shall be responsible for obtaining approvals from all relevant authorities with respect to his scope of Works and shall be responsible for the cost of all associated applications for approvals. The Contractor shall assist the Employer in obtaining sanctions of statutory authority (s) such as the Safety Commissioner as and when required.

1.10.3 The Contractor shall verify all interfacing information provided by relevant authorities and the Designated Contractors and ensure that the incorporation of such information will not affect the fitness for purpose of the Systems as defined in the Volume 3 part I for the operation and maintenance of the Kolkata Metro East West Line.

1.11 Materials and Workmanship

1.11.1 Materials utilised throughout the Works shall be free from defects and imperfections, unused and of recent manufacture and of a classification and grade in full conformity with the Contract.

1.11.2 Where standard specifications do not exist, materials shall be to the highest standard currently adopted within the industry and shall comply with the requirements of Technical Specification.

1.11.3 All materials, supplies or articles not manufactured by the Contractor shall be from recognised and reputable manufacturers acceptable to the Employer.

1.11.4 Products other than those named in the Contract shall be approved only when the Employer has been satisfied as to their strength, reliability and suitability. To assist the Employer in this respect, the Contractor shall furnish on request, performance data, references to completed works and any other relevant information together with samples of materials for approval.

1.11.5 Materials and any other articles adopted without the approval of the Employer shall be rejected.

1.11.6 The Works shall be constructed in accordance with the Good Industry Practice and shall comply with all local regulations and codes of practice which apply to such Works.

1.12 Standards

1.12.1 All of the Works shall comply with the standards and codes stated in this General Specification and in the associated Technical Specification.

1.12.2 Where no specific standard is stated, the Contractor shall follow recognised international and Indian Standards such as ISO, IEC, EN, NFPA, IS standards.

1.12.3 The Contractor shall submit a full list of standards which will be adopted in the performance of the Works prior to submitting any designs for approval.

1.12.4 When a Standard or Code is referred to, it shall be assumed that the revision current on the date of tender submission is applicable, unless otherwise stated.

1.12.5 The Contractor shall propose for the approval of the Employer in its design submissions the standards it proposes to use which shall include those quoted in the Specification. The Contractor may propose an alternative equivalent international standard during the design stage but the acceptance of the alternative standard shall be subject to review and approval by the Employer.

1.12.6 Should the Contractor wish to depart from standards stated in the Contract, or to furnish material under equivalent standards or specifications, he shall submit for approval by the Employer a statement of the exact nature of the departure fully supported by copies in English of equivalent standards and complete specifications of the alternative materials proposed.

1.12.7 Local laws and/or regulations and/or standards shall take precedence over any others in the event of conflict. Any conflict in requirements shall be brought to the attention of the Employer for resolution.

1.12.8 The Contractor shall provide copies in English of any standards, codes and regulations referred to in the Contractor's design and shall provide an English translation of the relevant sections where the original is not available in an official English version.

1.12.9 The Contractor shall ensure that items of equipment and their components are standardised wherever possible throughout the Works where similar requirements and functions exist.

1.13 Environmental Considerations

1.13.1 The Contractor shall be deemed to have taken into account all weather conditions arising from any cause whatsoever, including river flooding, excessive rainfall, salinity, temperature, humidity, high winds, lightning, or any other weather conditions and no compensation in any form shall be granted for delay, damage or disruption from these causes, save to the extent the same constitute an Force Majeure event under the Conditions of Contract.

1.13.2 Without limiting its liabilities under the Contract, the Contractor shall take all necessary precautions to protect the Works and Contractor's Equipment against the effects of weather, provided however Contractor shall inform the Employer in such circumstances which lead to stoppage of works.

1.13.3 The Contractor shall be responsible for obtaining and acting upon all relevant weather information and no work shall be performed when such work is liable to be injuriously affected by weather conditions.

1.13.4 The following information on climatic conditions in Kolkata shall be read as reference only and the Contractor shall be responsible for gathering relevant detail information from the appropriate sources which shall be taken into account in the design of the Works. In case information obtained by the Contractor varies significantly, the Contractor shall bring it to the notice of the Employer. All equipment, structures and systems including electrical, mechanical and hydraulic components shall be adequately specified for reliable and correct operation under these conditions.

Summer Temperature:

Outdoor Ambient Conditions	
Summer	
Dry Bulb Temperature:	35.2^{o}C
Wet Bulb Temperature:	28.6^{o}C
Monsoon	
Dry Bulb Temperature:	28.0^{o}C
Wet Bulb Temperature:	26.0^{o}C

Tunnel - Maximum Temperature – 45 deg C and Incoming air temperature rise to be restricted within 3℃

Fresh air requirement - As per ASHRAE 62.1.2007

Monsoon	
Dry Bulb Temperature:	Mechanical ventilation
Wet Bulb Temperature:	26.0^{o}C
Inside Station Design temperatures	
Upper Concourse (Un-Paid Areas)	Mechanical Ventilation
Lower Concourse (Paid Area) Upper Concourse (Paid Areas)	27^{o}C dry bulb, 60% RH

Platform	25 ^{o}C dry bulb, 60% RH
Minimum fresh Air / Person (In station Concourse & Platform areas) Equipment Rooms	**4.7 L/s per person or 1 L/s per m^2** whichever is greater. Number of people in room will be based on 30 m²/person or 2 persons, whichever is greater.

Air Velocity Criteria	Platform (Horizontal)	3.0 m/s average 5.0 m/s maximum
	Vertical Stairways and Escalators	1.8 m/s average 2.5 m/s maximum
	Tunnels (Emergencies)	11.0 m/s maximum
Concourse:		3 m² per person
Platform:		2.5 m² per person
Linkway & Entrances:		3.5 m² per person
Design Population		
Office:		Number of people will depend on the application of the office spaces such as Station Control Room, Ticket Office, etc. or based on 10 m²/person or 2 persons, which ever is greater.
Equipment Rooms:		Number of people in room will be based on 30 m²/person or 2 persons, whichever is greater.

1.13.5 The locations at which equipment may be installed have been divided into three environmental classes as shown in. The classes of environment are considered to become more extreme from A to C.

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

1.13.6 NOT USED

1.13.7 NOT USED

1.13.8 NOT USED

1.13.9 Equipment to be operated in climatically controlled environments, e.g. air conditioned rooms or ventilated rooms, shall be rated to work under the conditions given for the specific room.

1.13.10 The Contractor shall take additional precautions in selection of equipment, their protective enclosure and paint work in view of presence of high salinity in Kolkata environment.

1.13.11 Certain equipment will need to be rated at more onerous conditions as required in the Contract hereinafter and all equipment may be required to operate at higher temperatures and humidities under short term abnormal conditions.

1.13.12 Safety critical equipment installed externally shall be rated to work under the local rigorous conditions (such as high temperature, high humidity, pollution, or heavy rain) without any ventilation and air condition facilities.

1.13.13 All components and equipment of electronic, electrical, mechanical and hydraulic systems shall be suitable for the conditions prevailing at the site and shall be dust-tight.

1.13.14 IP ratings for all electrical components such as motors, cubicles, junction boxes, switches, sockets, electrical devices and accessories shall be as defined in IEC 60529.

1.13.15 Equipment provided with anti-condensation heaters shall be capable of operating without damage should the heaters be left on continuously.

2 MANAGEMENT PLANS

2.1 General

2.1.1 In order to ensure satisfactory execution of the Contract, completion of the Works within specified key dates and quality in installation and execution of the Work, a series of Management Plans shall be developed by the Contractor.

2.1.2 The following plans shall be developed and submitted by the Contractor for the Employer's review and approval:

(i) Project Management Plan

(ii) EMC Management Plan

(iii) Work Programme Plan (Work Programme and Design Submission Programme)

(iv) Quality Assurance Plan

(v) Quality Plan

(vi) System Safety Assurance Plan

(vii) Reliability, Availability and Maintainability Assurance Plan

(viii) Site Safety Plan

(ix) Software Quality Assurance Plan

(x) Environmental Plan

(xi) Inspection, Testing and Commissioning Plan

(xii) Operations and Maintenance Manuals submission Plan

2.1.3 The plans and related documents shall be co-ordinated with each other and shall collectively define, describe and encompass the Contractor's proposed methods, procedures, processes, organisation and sequencing of activities to meet the requirements of the General and Technical Specifications in respect of the subjects listed.

2.1.4 The respective plans shall be submitted as per the submission schedule furnished in the following table.

TABLE 2-1: SUBMISSION OF PLANS

S.No.	Plan	To be submitted within
1	Project Management Plan and Staff Organisation Plan	30 days of NTP
2	EMC Management Plan	60 days of NTP
3	Work Programme Plan (Work Programme)	30 days of NTP
4	Quality Assurance Plan	60 days of NTP
5	Quality Plan	60 days of NTP
6	System Safety Assurance Plan	60 days of NTP
7	Reliability, Availability and Maintainability Assurance Plan	90 days of NTP
8	Site Safety Plan	120 days of NTP
9	Software Quality Assurance Plan	120 days of NTP
10	Environmental Plan	120 days of NTP
11	Inspection, Testing and Commissioning Plan	120 days of NTP
12	Operation and Maintenance Documentation Plan	120 days of NTP

2.2 Project Management Plan

2.2.1 The Project Management Plan shall provide a clear over-view of the Contractor's organisation, the management system and methods to be used for completion of the Works. The organisation resources for the design, procurement, manufacture, installation, testing and commissioning, and setting to work and DLP inclusive of maintenance work shall be clearly defined.

2.2.2 The Contractor shall submit a Project Management Plan within the specified schedule. The Employer will review the Contractor's Project Management Plan and shall have the right to require the Contractor to make amendments as deemed necessary by the Employer. The Contractor shall submit a detailed revised plan within ten (10) days of the review of the Employer.

2.2.3 The Contractor shall submit a staff organisation plan for the approval of the Employer within fifteen (15) days of the Commencement Date.

2.2.4 The plan shall, as a minimum, identify all of the Key Personnel listed below. It shall show the qualifications and experience of all staff and shall show the Contractor’s management structure and state clearly the duties, responsibilities and authority of each member of staff.

2.2.5 The plan shall be updated and resubmitted whenever there are changes to the Contractor’s staff approved in accordance with the Conditions of Contract.

2.2.6 The Contractor’s Key Personnel shall include:

i) Project Manager;

ii) Contract / Scheduling Manager;

iii) Design Manager;

iv) System Interface Manager;

v) System Quality Manager;

vi) System Assurance Manager; and

vii) Safety, Health & Environment Manager.

2.2.7 The Contractor's Project Manager and his Key Personnel shall have experience appropriate to the type and scope of the Works and shall possess recognised university degrees or equivalent qualifications appropriate to their individual duties.

2.2.8 The Contractor shall employ, in connection with each speciality, supervisors who are suitably experienced in that speciality.

2.2.9 The supervisors shall be present at all times when work relating to that speciality is being carried out and shall directly supervise the personnel actually carrying out the tasks.

2.2.10 The Contractor shall submit details of the qualifications and experience of any specialist engineers, in addition to those listed above that it proposes to use in the major specialities required to design and implement the Works.

2.2.11 The Contractor shall implement a project information management system such that all documents generated by the Contractor can be transmitted to the Employer by electronic means (and vice versa) and that all documents generated by either the Contractor or the Employer are electronically captured at the point of origin and can be reproduced later, electronically in original format and in hard copy.

2.2.12 The Contractor shall ensure that computer software programs shall have built-in security procedures and security systems to permit the Employer's management to restrict access to specific portions of the programs or operation thereof, and/or to appropriate staff levels or departments.

2.2.13 The Contractor shall develop a sotware security plan in consultation with the Employer and submit the plan for the Employer's approval prior to the deployment of security procedures and security systems into software.

2.3 EMC Management Plan

2.3.1 The Contractor shall ensure that all electrical and electronic apparatus are designed and installed to operate without degradation of quality, performance or loss of function and data in the electromagnetic environment of the Project.

2.3.2 The design shall ensure that any electromagnetic interference emissions introduced into the environment do not exceed those detailed in the Specification. The Contractor shall ensure that his equipment is designed with the required immunity levels given in the Specification. In addition, the works shall be designed to limit the electromagnetic interface (EMI) to the nearby sensitive installations within the specified limits.

2.3.3 The Contractor shall develop and submit to the Employer for approval within the specified schedule, an EMC Management Plan which shall:

(i) describe EMC philosophy, activities, means of control on the EMC design;

(ii) define and describe the process and methods used for verification and validation of compliance with the required EMC parameters in all respects;

(iii) provide an EMC submission list which entails all relevant design documentations, test specifications and test reports for the demonstration of compliance, with a single paragraph description for each document;

(iv) entail a programme which shall identify all EMC submission dates .

(v) identify and provide details of a designate person nominated as the point of contact to deal with EMC matters for review without objection by the Employer. The same should apply to any subsequent change of this designated person.

2.4 Work Programme Plan (Works Programme And Design Submission Programme).

2.4.1 The Contractor shall prepare the Work Programme Plan, illustrated by sample schedules, charts, tables, etc., detailing his proposals for staff and their responsibilities to support the programming functions, for submission of works programmes for the Execution of the Works, for the design, manufacture, supply, installation, testing and commissioning, in accordance with the key dates for co-ordinating his programmes with those of Civil and other Designated Contractors, for measuring, monitoring and reporting progress, for revisions to the programmes to ensure completion of the Works within the specified times.

2.4.2 The Contractor shall submit the Work Programme Plan as per this General Specification for approval of the Employer. Based on the review, the Contractor shall promptly make all amendments as required by the Employer for his acceptance of the plan.

2.4.3 The Contractor shall develop and submit to the Employer within the specified schedule a Work Plan which shall contain the following:

(i) Proposed Works Programme.

(ii) Proposed Design Submission Programme.

2.4.4 The Contractor's proposed Works Programme shall indicate how the Contractor intends to organise and carry out the Works and achieve stages and complete the whole of the Works by the appropriate Key Dates. The Works Programme shall be prepared in terms of weeks from the Date of Commencement of Works.

2.4.5 In compiling its Works Programme and in all subsequent updating and reporting, the Contractor shall make provision for the time required for co-ordinating and completing the design of the Works, including, inter alia, design co-ordination periods during which the Contractor shall co-ordinate its design with the Employer, the Civil Infrastructure Contractors and all Designated Contractors, the approval procedures, determining and complying with the requirements of all Relevant Authorities and all others whose consent, permissions, authority or license is required prior to the execution of any of the Works.

2.4.6 The Works Programme shall take full account of the Design Submission Programme.

2.4.7 Particular attention shall be given to detailing the interfaces and coordination required with the Civil and Track Contractor for both the installation, testing and commissioning of Works.

2.4.8 The Contractor's Design Submission Programme shall cover the Design phase and include a schedule identifying, describing, cross-referencing and explaining the Design Packages and submissions, which he intends to submit.

2.4.9 The Design Submission Programme shall take due account of the design co-ordination interface periods with Civil Contractors and all Designated Contractors and be consistent with the Works Programme.

2.4.10 The Works Programme and Design Submission Programme shall include details as stipulated in this General Specification for review and approval by the Employer.

2.5 Quality Plan

2.5.1 The Quality Plan shall comply with the requirements of the Company's Quality Assurance 9001.

2.5.2 The Contractor shall provide the Employer with a detailed Quality Plan, which shall include details as stipulated in this General Specification for review and approval by the Employer and shall incorporate:

(i) A Management Quality Plan for control of management related activities;

(ii) A Design Quality Plan for control of design related activities;

(iii) A Manufacturing (including Factory Inspection and Testing) Quality Plan for the control of related manufacturing activities; and

(iv) A Testing and Commissioning (including Site and Integrated Testing and Commissioning) Quality Plan.

2.5.3 The Quality Assurance System shall be applied without prejudice to, or without in any way limiting, any Quality Assurance System that the Contractor already maintains.

2.5.4 The Contractor shall submit a detailed organisation chart identifying the responsibilities, authority and inter-relation of all personnel who manage, perform and verify work involving quality in respect of all Quality Plans. The organisation chart shall be specific to this Contract. The chart shall identify the Quality Management Representative who shall act as the Quality Co-ordinator for the Contractor in all dealings with the Employer.

2.5.5 The Contractor shall audit all the activities in each Quality Plan at quarterly intervals or at other such intervals as the Employer may require, to ensure continuing suitability and effectiveness of the quality management system. The Contractor shall make available upon request any document, which relates to his recent internal audits.

2.5.6 The Employer may require compliance audits of the Contractor's quality system to be conducted. Not less than two weeks notice will be given by the Employer. During audits, the Contractor shall provide suitably qualified staff to accompany the auditor.

2.6 System Safety Assurance Plan

2.6.1 The Contractor shall submit for review by the Employer, a System Safety Assurance Plan This Plan shall incorporate the contents of the Outline Safety Plan submitted with the Tender and shall include Hazard Analysis Plan, Fire Control Plan and EMC/EMI Control Plan.

2.6.2 The Hazard Analysis Plan shall evaluate and ensure that all the hazards are identified and satisfactorily addresssed/mitigated.

2.6.3 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 Technical Specification and also are compatible with currently accepted international practices. The FCP shall also indicate the criteria and predicted timings for the choice of materials (including paints), submission of test certifications and tests for materials and assemblies associated with the Works. The content of the FCP shall be consistent with and complement the overall requirements of the "System Assurance Plan" and the "Design Safety Studies".

2.6.4 The EMC Management Plan shall evaluate and ensure that the requirements for electromagnetic compatibility and interference as specified in this General Specification and the Technical Specification for all elements of the system are met.

2.6.5 Ergonomic Studies. The Contractor shall carry out ergonomic studies relating the scope of work.. Ergonomic Studies shall as a minimum comply with the principles and guidelines described in the following standards and regulations:

i) Health and Safety (Display Screen Equipment) Regulations – 90/270/EEC

ii) Ergonomic Principles in the design of work systems – ISO 6385

iii) Ergonomic Requirements for Office Work with Visual Display Terminals – ISO 9241

iv) Ergonomic Design of Control Centres – ISO 11064

Ergonomic Study reports shall be submitted prior to the "Design Safety Study" for the related equipment and shall be reviewed in conjunction with the "Design Safety Study".

2.7 Reliability, Availability And Maintainability Assurance Plan

2.7.1 The Contractor shall submit for review by the Employer, a Reliability, Availability and Maintainability Assurance Plan.

2.7.2 The Contractor shall describe procedures required to perform the specific tasks necessary to achieve RAM requirements in the Reliability, Availability and Maintainability Plan.

2.8 Site Safety Plan

2.8.1 The Contractor shall submit a Site Safety Plan as per requirements of this General Specification and SHE Conditions.

2.9 Software Quality Assurance Plan

2.9.1 The Contractor shall submit a Software Quality Assurance Plan in accordance with the requirements of 'Software RAMS Requirement' .

2.10 Environmental Plan

2.10.1 The Contractor shall submit an Environmental Plan, in accordance with the requirements of Technical Specification with particular reference to Noise, Vibration, EMC/EMI etc. The Environmental Plan shall incorporate the contents of the Outline Environmental Plan submitted with the Tender and shall include Noise and Vibration Plan and Environmental EMC Management Plan as per details furnished in the Technical Specification and SHE Document (Vol-IV) by the Employer.

2.11 Inspection, Testing And Commissioning Plan

2.11.1 The Contractor shall submit an Inspection, Testing and Commissioning Plan in accordance with this General Specification and Technical Specification.

2.12 Operations and Maintenance Manuals Plan

2.12.1 The Contractor shall submit an Operations and Maintenance Manuals Plan in accordance with this General Specification and Technical Specification.

3 INTERFACE MANAGEMENT AND COORDINATION

3.1 General Requirements

3.1.1 The Contractor is responsible for detailed co-ordination of his design, manufacturing and installation activities with those of the Designated Contractors and Consultants whether or not specifically mentioned in the Contract, who may be working on or adjacent to the site for the purpose of the Project.

3.2 Co-ordination with the Employer

3.2.1 The Employer will employ Consultants to work with their own staff in the implementation of the Works. The Consultants should be regarded as the Employer's staff unless formal instructions are given by the Employer in accordance with the Conditions of Contract.

3.3 Attendance On the Employer

3.3.1 The Contractor shall afford all necessary attendance upon the Employer and its nominated representatives including adequate means of access to all parts of the Works to assist him in carrying out his duties and responsibilities under the Contract. Such attendance shall not construe provision of full-time assistance

3.3.2 The Contractor shall assist the Employer and its nominated representatives, in respect of any country where works are to be carried out, in obtaining:

(i) necessary permits and licences for performing their duties;

(ii) necessary visas, licences, permits and Customs clearance for entry and exit.

3.3.3 The Contractor shall facilitate the clearance through customs of any equipment, materials and supplies required by and of the personal effects of the Employer and its nominated representatives.

3.3.4 The Contractor shall allocate at his works, and those of his major sub-contractors, adequate office space, furniture and equipment for the use of the Employer's Inspection Engineers. Such accommodation shall include secure filing space for documents, telephone, internet access and facsimile facilities. Such facilities shall apply equally to the overseas and the local building phases of the Works

3.3.5 The Contractor shall fulfill the attendance requirements as stipulated in this Contract or as deemed necessary by the Employer to fulfill the interfacing requirements. In particular, it is the Contractor's responsibility to provide attendance during installation, testing & commissioning of the interfacing system which will affect the system, works or plant provided or to be provided by the Contractor.

3.3.6 The Contractor shall identify and inform the Employer and the Designated Contractor of all necessary attendance from Designated Contractors which are not detailed in this contract.

3.4 Liaison with Others

3.4.1 The Contractor shall, under the overall direction of the Employer, interface the supply, installation, testing and commissioning of the Works with that of other parties, including, but not limited to the following parties:

(i) Governmental and utility agencies as nominated by the Employer;

(ii) The Civil Infrastructure Contractors;

(iii) Finishes Works Contractor

(iv) Each railway system's Contractor

(v) Other Designated Contractors as nominated by the Employer; and

(vi) The Operator and Maintainer.

3.4.2 For the purpose of interface coordination, the Contactor and the Designated Contractor may be assigned the leading role (referred as the Lead Contractor) or the matching role (referred as the Match Contractor) for the coordination, preparation and execution of an interface. For civil interface, the Contractor shall be the "Lead Contractor".

3.4.3 The assignment of the Lead and Match Contractors shall be alterable by written instruction from the Employer. This shall not be treated as a variation to the Contractor nor be used as a ground for any other claims.

3.4.4 Where there is no assignment of Lead and Match Contractor, the Employer will provide written instruction for the assignment within 30 days of contract award of the later contract of the two interfacing parties.

3.4.5 Both the Lead Contractor and Match Contractor shall jointly prepare the interface documents necessary for the execution of the interface. All interface documentations jointly developed are owned by both interfacing parties.

3.4.6 It shall be the responsibility of the Lead Contractor to secure, in a timely manner, from parties identified in accordance with the GS and TS, all interface information and criteria that will be required by the Contractor to carry out its obligations under the Contract.

3.4.7 The Lead Contractor shall incorporate input from the Match Contractors, prepare and submit the required interface document based on the interface requirements stipulated in this Contract.

3.4.8 Similarly the March Contractor shall provide, in a timely manner, the interface information requested by the Employer or the Lead Contractors

3.4.9 The Match Contractor shall provide the input as deemed necessary to the Lead Contractor in accordance with the agreed programme for exchange of design information.

3.4.10 The Match Contractor shall review and confirm the interface documentation prepared by the Lead Contractor and execute such interface specifications when Approved by the Employer.

3.4.11 The Contractor shall ensure compatibility of interface documentation between the Contractor and all other Designated Contractors.

3.4.12 Should the Match Contractor be unable to provide the required input to the Lead Contractor for a particular interface documentation required according to the agreed programme, the Lead Contractor shall still prepare and submit the said interface document to the best of his knowledge, and vice versa.

3.4.13 The Contractor shall keep the Employer fully informed in respect of such interfaces, such information being given to the Employer in a manner and form and at such intervals as may be required by the Employer.

3.4.14 The Contractor shall coordinate with the parties identified in accordance with this General Specification in the preparation and updating of the Works Programme.

3.4.15 The Contractor shall be responsible for identifying all internal and external interfaces and shall provide all relevant information and cooperate fully with the Engineer in the development and maintenance of a full interface management system, using an electronic database, which shall cover the functional and technical aspects of all the internal and external interfaces of the Contractor.

3.4.16 The Contractor shall coordinate with other Designated Contractors,. consultants, agencies etc, that the Employer may engage from time to time. Refer to the TS for a list of the major interface parties for the Contractor and the interfacing requirements with these Designated Contractors. The Contractor's co-ordination responsibilities shall include but not be limited to the following:

(i) To provide all information reasonably required by the Civil and Designated Contractors in a timely and professional manner to allow them to proceed with their Design, Manufacturing, Construction activities and to meet their milestones and key dates.

(ii) To ensure that the Contractor's requirements are provided to Civil and all Designated Contractors, in a timely and reasonable manner.

(iii) To obtain from the Designated Contractors information reasonably required, to enable the Contractor to meet his own design submission dates.

(iv) Where the execution of the work of the Designated Contractor(s) depends upon the site management or information to be given by the Contractor, the Contractor shall provide to such Designated Contractors the services, or the correct and accurate information required, to enable them to meet their own programme or construct their own works.

(v) To ensure that there is no interference with the works of the Designated Contractors.

(vi) To attend regular co-ordination meetings convened by the Designated Contractors and the Employer. The Contractor shall conduct separate meetings with the Designated Contractors as necessary to clarify Technical aspects of the Civil and other Designated Contractors' requirements of the Works. A record of the decisions taken in each such meeting shall be furnished to the Employer. The party who convenes the meeting shall prepare minutes recording all matters discussed and agreed at the meeting.

(viii) To ensure that all correspondence, drawings, meeting minutes, programmes, etc. relating to the Contractor's co-ordination with the Designated Contractors are issued to all concerned parties and four copies issued to the Employer no later than seven calendar days from the date of such correspondence and meetings.

3.4.17 The Contractor shall in carrying out his co-ordination responsibilities raise in good time and provide sufficient information for the Engineer to decide on any disagreement between the Contractor and the Designated Contractors as to the extent of services or information required to pass between them.

3.4.18 If such disagreement cannot be resolved by the Contractor despite having made all reasonable efforts, then the decision of the Engineer shall be final and binding on the Contractor.

3.4.19 Where any Designated Contractor is yet to be appointed, the Contractor shall proceed with the co-ordination activities with the Engineer until such time as the Designated Contractor is available. The Contractor shall provide the Designated Contractor with all information necessary to enable the Designated Contractor to follow-on and proceed with their co-ordination.

3.4.20 Any claim of additional costs by the Designated Contractors as a result of the Contractor's failure to keep to specified dates shall be borne by the Contractor. The Contractor shall note that the information exchange is an iterative process requiring the exchange and updating of information at the earliest opportunity and shall be carried out on a regular and progressive basis in order for the process to be completed for each design stage by the specified dates. The Employer shall have full right to impose liquidated damages on the Contractor should there be an impact of these delays in achieving the key dates. The decision of the Engineer shall be final and binding.

3.5 Dedicated Co-Ordination Team

3.5.1 The Contractor shall establish a dedicated co-ordination team, led by a Co-ordinator reporting to the Contractor's Project Manager. The primary function of the team is to provide a vital link between the Contractor's design and manufacturing teams and the Designated Contractors. The Contractor shall provide the Employer with particulars of the Co-ordinator. The Employer may request replacement of the Co-ordinator if in his opinion the Co-ordinator is unable to meet the co-ordination requirements of the Contract. The Co-ordinator shall establish effective dialogues and communication links with the Designated Contractors. The Contractor’s co-ordination team shall comprise a mix of personnel with experience in both design and manufacture of equipment comprising the Works necessary for effective co-ordination.

3.5.2 The Co-ordinator shall assess the progress of co-ordination with Designated Contractors by establishing lines of communications and promoting regular exchange and updating of information so as to maintain the Contractor's programme

3.5.3 The complexity of the project and the importance of ensuring that work is executed within time limitations require detailed programming and monitoring of progress so that early programme adjustments can be made in order to minimise the effects of potential delays.

3.5.4 The Co-ordinator in conjunction with the Designated Contractors shall identify necessary provisions in the Works for plant, equipment and facilities from the Designated Contractors. These provisions shall be allowed for within his scope of the Works.

3.5.5 In the course of the project, information could be obtained in a number of ways, including direct inspection, regular site meetings, the obtaining of progress reports and the use of turn round documents to obtain design and programme data. Turn round documents shall be issued to the Designated Contractors to be returned giving the current positions on their programme.

3.6 Design Co-ordination

3.6.1 The Contractor shall undertake design coordination with the Employer and Designated Contractors within the periods for design interfacing and co-ordination in the agreed Works Programme.

3.6.2 Design coordination shall include, but not be limited to, the following:

3.6.3 Definition and agreement with the parties of interface areas and contract limits, shared loads and sequence of design activities.

3.6.4 Agreement with the Employer on all human machine interfaces including graphic displays, text messages and reports.

3.6.5 Agreement with the Employer on all aspects of system functionality.

3.6.6 Definition and design approach by the Contractor with the parties identified in Clause 3.4.1 of this General Specification for type, size and location of trainborne equipment, access thereto, cable routing and protection, agreement of installation programming and preparation of the associated interface documentation.

3.6.7 Apart from the Design Submission and Approval process, the Contractor shall organize and convene Design Workshop locally with the relevant interface contracts, relevant parties and authorities (if necessary). Design Workshop's content, venue and timing shall be agreed and approved by the employer. There are 2 stages of Design Workshop (namely stage 1 and stage 2), each stage with the a minimum duration of 2 days

<u>Stage 1 Design Workshop :</u>

Shall be convened 1 month after the award of the contract including but not limited to below items;

(a) All interfaces (physical, spatial, functional) required or provided for others under the contract. All interfaces shall fit for purpose and agreed (in terms of type, quantity, where and how) and signed-off by concerned interface parties for implementation.

(b) All major equipment delivery route and access openings shall be identified and confirmed.

<u>Stage 2 Design Workshop :</u>

Shall be convened 3 months after the award of the Contract including but not limited to below items;

(a) All Contract requirement and TS (Technical Specification) clauses shall be checked and confirmed for compliance.

(b) All internal system interfaces (both hardware and software) shall be checked and approved prior implementation

3.6.8 The objective of these Design Workshops is to establish substantial agreement on the following elements of design. Thereupon an agreement shall be signed by both interfacing contractors at the end of each workshop.

i.) system configuration, programme for provision of interface and operating information required from the Employer and third parties;

ii.) system functionality; and

iii.) human machine interfaces.

3.6.9 The Contractor shall undertake design coordination with the external parties identified in Clause 3.4.1 of this General Specification within the periods stated for design interfacing and coordination in any related interface documents.

3.6.10 The Contractor shall liaise with the Employer in developing a uniform identity code system which shall be used to uniquely identify each item of equipment and software components provided under this Contract.

3.6.11 Such identity codes shall be used for labelling each item of equipment and shall also be used in design reports, drawings and operations and maintenance manuals.

3.6.12 Such codes shall comprise mnemonics for location names and equipment types as well as alphanumeric for unique numbering.

3.6.13 This identity code system shall be generally compatible with principles to be established by the Employer's and shall specifically be compatible with the use of the Employers defined names, mnemonics and codes for stations.

3.7 Interface Documentation

3.7.1 As a minimum, the Contractor shall coordinate with the Designated Contractors to prepare and submit the following interface documents:

i) Detailed Interface Specification (DIS)

ii) Detailed Interface Test Plan (DITP)

iii) Interface Test Procedure (ITSP)

iv) Interface Test Report (ITR)

3.7.2 Detailed Interface Specification (DIS)

a) A DIS is required for each pair of interfacing contracts, i.e. this Contract and each Designated Contract and be submitted for the Approval of the Employer.

b) The DIS shall cover the design of the physical, electrical, mechanical, functional, protocol, software and all other interface design between this Contract and the Designated Contract.

c) The DIS shall show clearly the demarcation of responsibilities between the Lead Contractor and Match Contractor for an interface.

d) The DIS shall contain typical sections described in the following table as a general guidance. Contents can be included as per the specific requirements of an interface:

Table 3.7.1 Detailed Interface Specification

1	Purpose
2	Reference Documents
3	Abbreviations / Glossary
4	Interface Specifications
	4.1 Interface Demarcation Diagram
	4.2 Physical Interface
	4.2.1 Nature, Location and Quantity
	4.2.2 Electrical Description
	4.2.3 Mechanical Description
	4.3 Functional Interface
	4.4 Protocols
	4.5 Software and Data Interface
	4.6 Naming Convention
	4.7 Design Constraints
	4.8 EMI/EMC
5	Implementation and Installation
6	Quality Assurance
7	Verification & Validation
	Appendices and Drawings
	Appendix A - Detailed Data Interface Schedule
	Appendix B - Cable Termination Schedule
	Appendix C – System Start-up Parameters

3.7.3 Detailed Interface Test Plan (DITP)

a) The Contractor and Designated Contractor shall jointly develop the DITP and submit to the Approval of the Employer.

b) The DITP shall identify various tests required to ascertain the proper interfacing and interaction as required and shall cover the purpose, methodology, sequence, testing instrument, inputs and expected outputs, responsibility of the Contractor and Designated Contractor in each test.

c) The DITP shall show clearly the demarcation of responsibilities between the Contractor and Designated Contractor.

d) The DITP shall contain typical section described in the following table as a general guidance. Contents can be included as per the specific requirements of an interface:

Table 3.7.2 Detailed Interface Test Plan

Detailed Interface Test Plan	
1	Purpose
2	Reference Documents
3	Abbreviations / Glossary
4	Test Methodology
5	Interface Test Schedule
	*5.1 Test AAA-BBB.01
	5.1.1 Purpose of this test
	5.1.2 Reference to TS and DIS
	5.1.3 Test Configuration
	5.1.4 Testing Equipment
	5.1.5 Test Procedure with inputs and expected outcome
	5.2 Test AAA-BBB.02
	5.2.1 Purpose of this test
	5.2.2 Reference to TS and DIS
	5.2.3 Test Configuration
	5.2.4 Testing Equipment
	5.2.5 Test Procedure with inputs and expected outcome
	(….. repeat for all tests …..)
6	Logical Sequence and Dependence of the Tests
7	Quality Assurance
8	Verification & Validation
	Appendices and Drawings
	App A – Test Records

* - AAA and BBB represent the abbreviations of the Contractor and Designated Contractor

e) Depending on the interface, there may not be any functional interface between the Contractor and Designated Contractor which only physical/electrical/mechanical interfaces exist. In such cases, a Detailed Interface Inspection Plan (DIIP) may take place instead of a DITP. However, this shall be indicated in the DIS subject to the Approval of the Employer or as specified in the IRS.

f) For the DIIP, the contents are expected to be similar to the test plan but with a focus on physical inspection of the interface requirements. An ITSP will not be necessary under this condition.

3.7.4 Interface Test Specification (ITSP)

a) The ITSP shall be a detailed test specification for each interface test item identified in the Interface Test Schedule in the DITP. It shall be jointly developed by the

Contractor and Designated Contractor and submitted for the Approval of the Employer.

b) For each interface test item, the following contents shall be included in the ITSP:

(i) Purpose of this test

(ii) Reference to TS or DIS

(iii) Test Pre-requisites

(iv) Detailed Test Configuration

(v) Testing Equipment

(vi) Step-by-step Test Procedures with required inputs, expected outcomes and acceptance criteria

(vii) Test Record

c) The division of responsibilities must be clearly indicated as part of the Test Configuration section.

d) Other information such as the expected duration and safety precautions of the tests shall also be included in the ITSP

e) The step-by-step test procedures shall demonstrate that the required functionality of the interface is fulfilled. Each test shall be repeatable and consistent test results shall be achieved under same testing conditions.

3.7.5 Interface Test Report (ITR)

a) An ITR shall document all test results recorded during the interface testing.

b) All test records shall be duly signed by the representative of the Contractor and Designated Contractor.

c) In Inspection Report will take place for those interfacing parties without any functional testing as referenced in Clause 3.7.4.

3.7.6 The dates for the above submissions shall be detailed in the submission schedule for Approval by the Employer.

3.7.7 All relevant interface documents shall be updated with the changes clearly highlighted or annotated in the documents and re-submitted to the Employer for Approval. All interface documentation shall be kept up to date throughout the project lifecycle.

3.8 Installation Co-ordination

3.8.1 The Contractor shall coordinate with the Employer with respect to all installation activities and shall follow the Employer's rules for requesting access for such activities.

3.8.2 The Contractor shall undertake installation in accordance with the approved Works Programme.

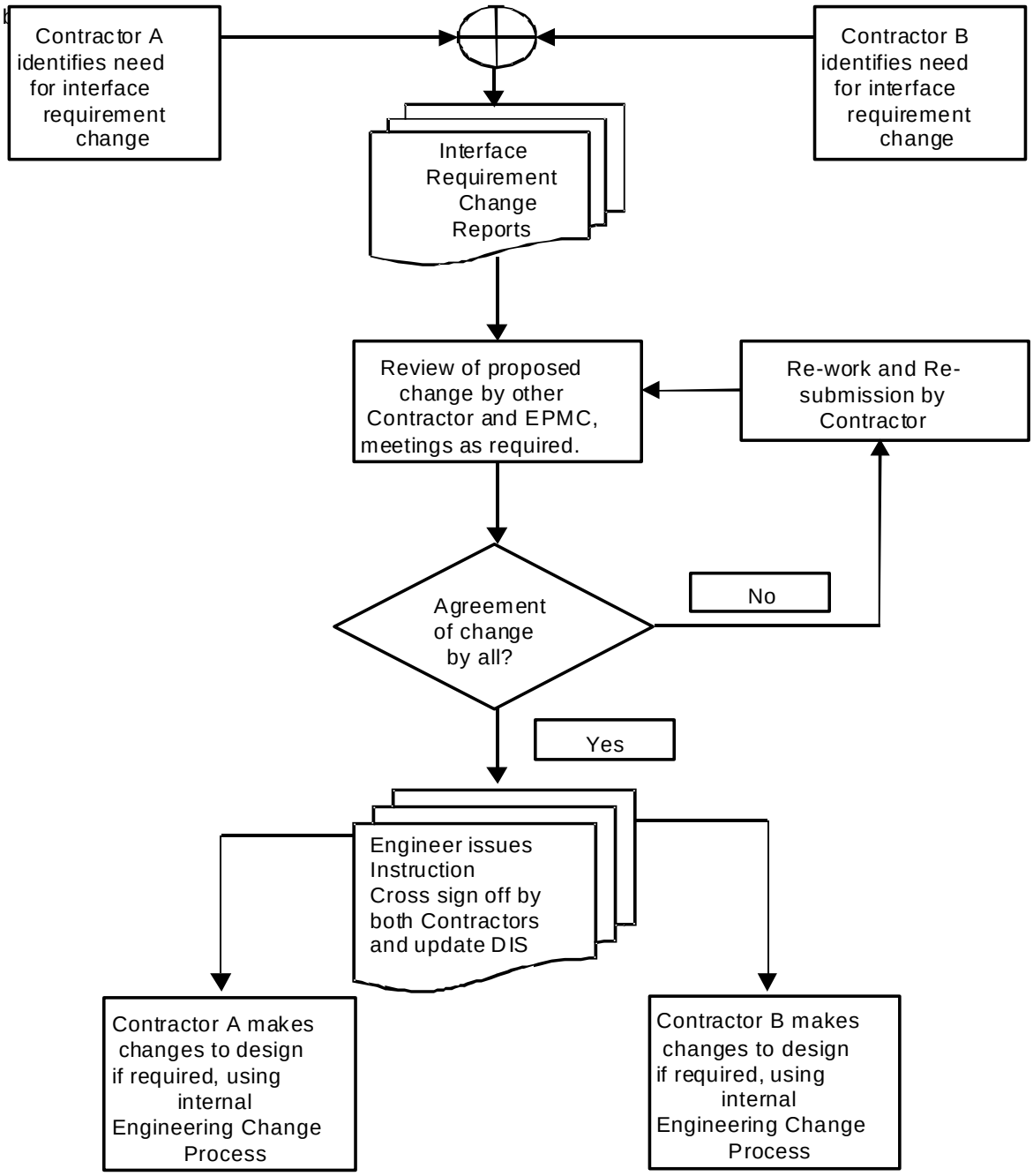
3.8.3 It shall be a requirement for the Contractor to define more closely with the Designated Contractors the details of its activities within areas where work is to be carried out simultaneously and to require the same to be described in Coordinated Interfacing and Installation Programmes.

3.8.4 For physical, mechanical or electrical interface requirements and associated interface activities between the Contractor and Designated Contractor, refer to the corresponding IRS.

3.9 Interface Change Control

3.9.1 Detailed interface design shall be carried out in accordance with the requirements specified in the TS and IRS. Any necessary potential changes to these requirements as a result of detailed design development shall be properly assessed with respect to scope of work, cost and programme with the results made known to the Employer. Implementation of such potential changes shall only be by instruction issued by the Employer. Any known impact on the works of Designated Contracts or other contracts that could lead to variations in those contracts shall equally be made known to the Employer.

3.9.2 A typical flow of the sequence of events for an interface change is indicated in the flowchart below:


Contractor A identifies need for interface requirement change
Contractor B identifies need for interface requirement change
Interface Requirement Change Reports
Review of proposed change by other Contractor and EPMC, meetings as required.
Re-work and Re-submission by Contractor
Agreement of change by all?
No
Yes
Engineer issues Instruction Cross sign off by both Contractors and update DIS
Contractor A makes changes to design if required, using internal Engineering Change Process
Contractor B makes changes to design if required, using internal Engineering Change Process

3.10 Integrated Testing and Commissioning Co-ordination

3.10.1 The Contractor shall co-ordinate with the Employer with respect to all testing activities and shall follow the Employer rules for requesting access for such activities.

3.10.2 The Contractor shall, with the Employer and Operator, undertake the defined role in the co-ordination of the activities associated with Integrated/interface Testing and Commissioning and Trial Running including the co-ordination with the Designated Contractors to integrate and monitor their systems to prove the design, integrity and safety of the all the systems incorporated in the Works.

3.10.3 The Contractor shall co-ordinate with the Employer regarding O&M Documentation.

4 WORKS PROGRAMME AND REPORTING

4.1 Programme General

4.1.1 Unless otherwise agreed by the Employer, all programmes including Works Programme and Three Month Rolling Programme shall be produced in accordance with the Appendix 1.

4.2 Work Programme Plan

4.2.1 The Contractor shall submit the Work Programme Plan in accordance with the Clauses 2.4 of the General Specifications.

4.3 Works Programme

4.3.1 Within 60 days of Notice to Proceed the Contractor shall submit to the Employer a Works Programme, as detailed in Appendix 1, in accordance with the Clauses 4.2.2 to 4.2.11.

4.3.2 The Works Programme shall include all major activities for design, manufacturing, delivery, installation, testing and commissioning, test running and trial running. The contractor shall also incorporate the Employer's requirments for additional activities.

4.3.3 In preparing his Works Programme the Contractor should note the following conditions will apply;

a) The Contractor shall not have exclusive access to any part of the Site except by specific agreement with the Employer.

b) The Contractor shall take note that concurrent time allocations for certain areas have been given to more than one contractor. The Contractor shall co-ordinate his work in such areas with that of Designated Contractors.

c) The absence of a programme date or installation period for the Contractor in a specific area shall not prejudice the right of the Employer to establish a reasonable date or installation period for the area.

d) The Contractor shall complete by specific dates at particular locations (as referred to in the TS) general installation works such as conduit, ductwork, cable trays, pipes, switches, isolators, cables, fixtures and fittings which obstruct major architectural builder's and finishes work and System installation by Designated Contractors.

e) The Contactor shall deliver all Plant and equipment for stations and ventilation shafts by road and via temporary access openings unless agreed by the Employer. The Employer shall not provide the Works Train.

4.3.4 The Contractor shall note that at the time of submission of his Works Programme, it may be that such Programme has yet to be co-ordinated with the Civil and other Designated Contractors. These shall not prevent the Contractor from submission of detailed preliminary programmes using approximate dates for interface work with the Civil and other Designated Contractors (where such dates are not available), which has impact on the Contractor's programmes. The Works Programme shall be amended subsequently to take into account the actual schedules of the Civil and other Designated Contractors as directed by the Employer. It is the Contractor's responsibility to ensure timely co-ordination with the Civil and

other Designated Contractors to finalise his preliminary programmes so as not to affect the progress of the Works or those of the Civil and other Designated Contractors.

4.4 Baseline Programme

4.4.1 It is the Contractor's responsibility to ensure timely co-ordination with the System-wide and Civil Contractors to review, revise and finalise his Works Programme so as not to affect the progress of the Works and those of the System-wide and Civil Contractors.

4.4.2 The Works Programme, or its subsequent revisions, when accepted by the Employer shall form the Baseline Programme against which actual progress of the Works is measured.

4.4.3 The contractor shall re-submit the Works Programme 90 days before site work commencement with sufficient details of installation, testing and commissioning to the satisfaction of the Employer.

4.4.4 As the Works progresses, it may be necessary for the Contractor to revise the Baseline Programme but such revision shall only be carried out with the prior approval of the Employer or when directed by the Employer.

4.4.5 The Contractor shall programme its work at all times to meet the Key and Access Dates stated in the Conditions of Contract and to coordinate the specified interface periods for the design and installation of the Works with those of Civil Infrastructure Contractors and all Designated Contractors and shall, during the progress of the Works, constantly monitor its progress against the Baseline Programme.

4.4.6 Not used.

4.4.7 The Works Programme shall show the Contractor's plan for organising and carrying out the whole of the Works.

4.4.8 The Contractor shall submit Precedence Diagramming Method logic network when requested by the Employer from time to time to assist him in the analysis of the Contractor's Programmes.

4.4.9 The Employer may at any time during the course of the Contract require the Contractor to submit the computer generated Scenario Report to generate schedules based upon "what if" statements. The format and contents of the Scenario Report shall be approved by the Employer.

4.5 Progress Reports and Three Month Rolling Programme

4.5.1 Progress reports, as detailed in Appendix 2, shall be submitted by the Contractor on a monthly basis.

4.5.2 The Three Month Rolling Programme, as detailed in Appendix 1, shall be included in the Progress Reports.

4.6 Review Periods For Contractor's Programme Submissions

4.6.1 The Employer shall review those Contractor's programme submissions which require his acceptance and shall signify his acceptance or otherwise within 30 days. The Contractor

shall, when required by the Employer, re-submit his programmes within 14 days of receipt of the Employer's comments.

4.6.2 The Employer will endeavour to review and respond to the Contractor on the adequacy and acceptability of the Contractor's submissions and re-submissions as soon as reasonably possible but the Contractor should always provide for a 30 day review period.

4.6.3 Unless otherwise specified, the Contractor shall provide in his programme a 30-day review period for all submissions to the Employer.

4.7 Failure to Make Submissions

4.7.1 Failure of the Contractor to submit any programme, or any required revisions thereto within the time limits stated shall be sufficient reason for certification that the Contractor is not performing the work required in a timely manner. The Employer may certify retention of payment under the relevant Schedule of Payments proposed for the Contractor, until his programmes are accepted by the Employer, and may also cause imposition of Liquidated Damages.

4.8 Programme Revision

4.8.1 The Contractor shall revise his programmes whenever necessary, with the consent of, or as required by the Employer to ensure completion of the Works within the times for completion prescribed in the Contract.

4.9 Planning and Programming Staff

4.9.1 The Contractor shall employ sufficient number of planning and programming staff competent in the use of the programming software and with a good knowledge of the type of work required to be performed by the Contractor under the Contract. The Employer shall have the discretion to require the Contractor to replace his planning and programming staff if the Employer considers that they do not have the training or skill required for this very specialised nature of work.

4.9.2 Not Used

4.10 Project Calendar

4.10.1 Project Weeks shall commence on a Monday. A day shall be deemed to commence at 0001 hours on the morning of the day in question. Where reference is made to the completion of an activity by a particular week, this shall mean by midnight on the Sunday of that week.

4.10.2 Requirements for the computation of Key Dates are given in Appendix 3.

4.10.3 A 7-day week calendar shall be adopted for various Work Programme Schedules for scheduling purposes.

4.10.4 For Project purposes, the presentation shall be in "Week" units.

4.11 Method Statements

4.11.1 The Contractor shall submit its proposed list of method statements detailing the specific steps that shall be followed for safe and correct delivery and testing of the works.

4.11.2 Prior to any activity for which a method statement is required, the Contractor shall have obtained the Employer's approval to its method statements for such activity.

4.12 Programme Management

4.12.1 The Contractor shall implement and use throughout the duration of the Contract, a computerised system to plan, execute, maintain and manage the planning, design, manufacture, installation, and Sub-contracts in executing the CPM scheduling by PDM.

4.12.2 The reports, documents and data provided shall be an accurate representation of the current status of the Works and of the work remaining to be accomplished; shall provide a sound basis for identifying problems, deviations from planned works, and for making decisions; and shall enable timely preparation of the same for presentation to the Employer.

4.12.3 Programming software shall be Primavera Project Management Release 6.0 or later version, obtainable from Primavera Systems Inc.

4.12.4 Should the Contractor wish to propose an alternative programming software, he shall demonstrate to the Employer the proposed software's capability for direct data exchange with Primavera Project Management Release 6.0 or later version. Such data exchange compatibility shall include, but not be limited to activity and resource coding. Full electronic data transfer to Primavera is required. The various levels of reporting and coding capabilities shall be at least equivalent to Primavera. Comparable performance between Primavera and the Contractor's proposed system shall be demonstrated. Scheduling Software and relevant instruction manuals, licensed for use in connection with the Contract, shall be provided by the Contractor.

4.12.5 Should the Employer accept the Contractor's proposed software, the Contractor shall supply the Employer with an original copy, including manuals and approved training, of the software and any subsequent versions thereof at no extra cost.

4.12.6 All terminology, definitions and conventions shall be in accordance with BS 4335 (Glossary of terms used in Project Network Techniques) or the Associated General Contractor's (AGC) manual entitled "The use of CPM in Construction".

4.12.7 All submissions shall be in seven (7) paper copies and shall be in A0, A1, A3 or A4 size, as appropriate except as may otherwise be agreed by the Employer. In addition, the submissions shall also be made in electronic format in a medium acceptable to the Employer.

4.12.8 All programme submissions shall, unless otherwise specified, conform to the format and level of detail specified in Appendix 1 to this General Specification.

5 DESIGN SUBMISSIONS

5.1 General

5.1.1 The objective of the design submission process is to ensure that the proposed resulting Works comply with the specifications, are capable of being produced consistently to exacting quality standards, achieve low life cycle costs and can be operated safely to the satisfaction of the Employer.

5.1.2 The design submissions include without limitation Design Calculations, Design Reports and Design Drawings.

5.1.3 In the event that a statutory body requires design information in a particular format, it shall be incumbent upon the Contractor to provide the same, as directed by the Employer.

5.1.4 Design submissions shall be made in the English language. Where design documents are created in a language other than English, these should be submitted complete with a full translation in the English Language duly certified by a certified translator.

5.1.5 As soon as practicable after Contract Award, the Contractor shall review all applicable data, criteria, standards, directives and information provided to him as the basis for design. Any apparent inconsistencies or erroneous information shall be brought to the attention of the Employer. Such information shall not alleviate the Contractor from his responsibilities under the Contract.

5.1.6 Drawings and CAD data shall comply with the requirements of Appendix 4 to this General Specification. Reports, calculations, specifications, technical data and similar documents shall be provided in A4 format, and one of the copies shall be ring bound to facilitate photocopying. A3 size drawings included in documents shall be folded to A4 size.

5.1.7 Within 30 days of Notice to Proceed, the Contractor shall have prepared and submitted the drawing and CAD procedures together with sample drawings and corresponding CAD data to demonstrate his understanding and compliance with Appendix 4 to this General Specification relating to CAD data format.

5.1.8 The following quantities of drawings and other documents shall be submitted to the Employer, including definitive, detailed and final design submissions, the final contract document, and all other submissions. These drawings and documents are in addition to those required for the exchange of information between Designated Contractors and other submissions to statutory, governmental and local authorities.

(i) 7 full-size sets of paper drawings (folded and collated)

(ii) 7 sets of design documents and calculations.

(iii) copies of Design Status Report and Design Statement.

(iv) sets of all other submissions.

(v) sets of each of the above in electronic format

5.1.9 In addition to the express requirements herein, the Contractor shall, whenever the Employer so requests, provide information and participate in discussions that relate to design matters.

5.1.10 The Contractor shall pay particular attention to the quality assurance (QA) requirements in this General Specification.

5.1.11 The Employer may audit from time to time compliance with the approved QA requirements as they relate to the design process and reject submissions should the Contractor fail an audit.

5.1.12 No approval, agreement or statement of no objection from the Employer or Relevant Authorities relating to a design document submitted from the Contractor will release the Contractor from his responsibilities under this Contract.

5.1.13 All meetings and discussions with the Employer relating to design submissions shall be held in Kolkata or other mutually agreed location.

5.2 Design Report

5.2.1 The Contractor shall, on a monthly basis, during the design stage submit to the Employer a "Design Report".

5.2.2 The report, as a minimum, shall contain the following:

(i) a submission schedule for all proposed submissions indicating submissions made during the month, submissions to be made in the next month and status of previous submissions (agreed, no objection, rejected, etc);

(ii) a list of ongoing design submissions with an indication of the progress and level of completion;

(iii) a list of responsible designers for the outstanding design works;

(iv) a list and commentary of outstanding information or design decisions which are affecting design progress; and

(v) an "S Curve" reporting of overall design progress.

5.3 Submittals Schedule

5.3.1 Within thirty (30) days of the Commencement Date the Contractor shall prepare in consultation with the Employer and submit to the Employer for approval a Submissions Schedule which shall list all drawings, designs, plans, test procedures, test reports, manuals, system assurance supporting documents and all other documents required to be prepared by the Contractor in connection with the Works and shall comply with the following requirements.

5.3.2 Identify each item with a title that clearly indicates the nature of the submission;

5.3.3 Identify each item which is defined as being safety-critical such that it is readily distinguishable from other submissions;

5.3.4 Group submissions according to the disciplines that will generate them (such as mechanical, electrical, interior fittings etc);

5.3.5 Order submissions within each group in roughly chronological order by type of document as follows: Plans, Definitive Design, Detailed Design, Materials, Methods Statements, Test Procedures, Test Reports, System Assurance supporting documents, Operations and

Maintenance Manuals, Training Documents, As Constructed Documentation and Other Documents;

5.3.6 Provide anticipated dates for submission of each item to the Employer;

5.3.7 Provide an indication of the period within which the Contractor proposes that the Employer should be required to respond to the each item submitted by the Contractor;

5.3.8 Provide columns for actual dates of submission and for references to related correspondence from the Contractor to the Employer and the Employers response;

5.3.9 Provide a column for the status of each submission.

5.3.10 The Submissions Schedule shall be based on the Contractor's anticipated programme for the preparation, submission and approval of Design Documentation and all dates quoted shall:

(i) be in accordance with the Works Programme;

(ii) make adequate allowance for design development of specialist work; and

(iii) make adequate allowance for design interfaces and co-ordination periods for each of the Civil Infrastructure Contractors and all Designated Contractors.

5.3.11 The Submissions Schedule shall not stipulate a period of less than:

(i) Forty two (42) days from the receipt thereof by the Employer for the response to any Definitive Design submission;

(ii) Thirty five (35) days in the case of a Detailed Design submission; and

(iii) Twenty eight (28) days in the case of a Test Procedure, Test Report, Operation and Maintenance Manual or As Constructed Documentation submission.

5.3.12 The Submissions Schedule shall be a live document and shall be updated at least on a monthly basis and be included as part of the monthly report.

5.3.13 The Contractor shall keep the Submissions Schedule on a live database which shall be updated daily and to which the Employer shall be granted permanent on-line access for monitoring purposes.

5.3.14 The Submissions Schedule shall provide a complete history of the submission and approval process and the record of all submissions shall be retained even where items are resubmitted to respond to the Employer's comments or objections.

5.3.15 The Contractor shall continue to update the Submissions Schedule until the last revision of all items is recorded as closed by the Employer whether this is by approval, advice of no objection or acknowledgment according to the nature of the submission.

5.4 Submission Process

5.4.1 The Contractor shall undertake the design in two stages as follows:

(i) Design Verification sufficient to verify the system design received in tender documents to permit manufacturing to commence; and

(ii) Detailed Design Engineering sufficient to permit installation.

5.4.2 Designs shall comply with the requirements of the Specification.

5.4.3 Requirements within the Specification for specific information to be submitted shall not in any way limit the design information required by the Employer for approval.

5.4.4 Designs shall be fully co-ordinated and interfaced with the Rolling Stock Contractor, the Civil Infrastructure Contractors and all other Designated Contractors in accordance with the Contract.

5.4.5 The Contractor shall co-ordinate with the Relevant Authorities and shall be responsible for ensuring that the Employer obtains all required approvals from Relevant Authorities, which relate to its design submissions.

5.4.6 Submittals that include any item defined as Safety Critical shall be readily distinguishable as such and shall specifically reflect the risk assessment carried out on the item.

5.4.7 The Contractor shall develop and maintain a full configuration control management system to ensure that following the Advice of No Objection of all designs any functional, technical or software changes, for whatever reason, are recorded and controlled by the Contractor.

5.4.8 This shall be used in co-ordination with the asset management system to record versions of all installed hardware, software and firmware systems and components.

5.5 Design Verification

5.5.1 The Design shall be verified to the stage at which all elements are fully defined and all functionality is fully described.

5.5.2 Design packages are to relate to significant and clearly identifiable parts of the proposed Definitive Design and shall address the design requirements as described herein.

5.5.3 Design packages shall facilitate the approval and understanding of the Definitive Design as a whole and shall be verified, reproduce based on that and submitted in an orderly, sequential and progressive manner.

5.5.4 Separate verified Design submissions may be prepared for those major elements to be procured by Sub-contract and which Sub-contracts include design.

5.5.5 Verified Design submissions shall include, without limitation, the following documents:

(i) drawings which comprehensively illustrate the proposed hardware configurations and functionality supported;

(ii) functional descriptions which comprehensively define the software architecture and the functionality supported;

(iii) specifications which comprehensively specify the materials and workmanship, manufacture and installation of the Definitive Design; and

(iv) interface reports which provide a complete schedule of interfaces with the Existing System setting out the interface boundary, a technical description of the interface, in

sufficient detail to confirm compatibility.

5.6 Design Engineering

5.6.1 The Detailed Design Engineering shall conform to the Approved Definitive Design and shall complete the design in all respects and include the production of the manufacturing and installation drawings, the purpose of which are to illustrate all of the Works and to be the drawings governing manufacture and installation.

5.6.2 The drawings shall delineate the detailing for installation of the Approved Definitive Design and shall show in full the works to be manufactured and installed.

5.6.3 Detailed Designs showing installation details shall be submitted for the Employer's approval in order to satisfy the Employer that overall equipment layouts and installation details are acceptable and adequately integrated with the works of the Civil Infrastructure Contractors and all Designated Contractors.

5.6.4 Detailed designs shall also include the details of all human machine interfaces including both operator and passenger user interfaces and all computer output in the form of files, screen displays and printed reports.

5.7 Submission and Approval of Design Documentation

5.7.1 The Contractor shall submit seven sets of hard copies of all drawings and data within a submission and transfer such documents, electronically to the agreed format, to the Employer in accordance with the updated, approved submittal schedule or otherwise as requested in writing by the Employer. Design submission shall be achived via web-based Electronic Document Management System (EDMS) employed by the Employer. The contractor shall be responsible for the cost associated with the EDMS licence and its connection to the Employer system.

5.7.2 Design submittals shall be reviewed by the Employer to ensure that the designs are in accordance with the Contract requirements, with accepted codes of practice, with declared design standards and with all directives and are in accordance with safe engineering practice.

5.7.3 Each design submittal shall be sufficiently detailed for the Employer to conduct a detailed review but shall not necessarily comprise a total design.

5.7.4 Each design submittal shall be supported as appropriate by:

i) system block diagrams;

ii) calculations;

iii) functional descriptions;

iv) construction drawings showing equipment locations;

v) fixing, mounting and cabling arrangements;

vi) catalogues;

vii) samples;

viii) design evaluation criteria;

ix) reliability analysis

x) FMEA / FMECA.

5.7.5 Each design submittal shall include cross-references to the requirements of the Technical Specification relating to the Works and the standards on which the design is based.

5.7.6 Each submittal shall be accompanied by a table (or other suitable method) providing a demonstration of traceability (Verification and Validation) of the information within the submittal, to "parent" document(s) and shall identify future "child" submittal(s) which provide further details of the design as follows:

5.7.7 **Design Verification** submittals shall be accompanied by a table of clause references and demonstration of compliance to the Technical Specification(s)

5.7.8 **Design Engineering** submittals shall be accompanied by a table of clause references to the Definitive Design documentation

5.7.9 **Test and Commissioning Procedures** shall be accompanied by a table of clause references to the Design (either Definitive or Detailed)

5.7.10 **Test and Commissioning Results** shall be accompanied by a table of clause references to the Test and Commissioning Procedures

5.7.11 Following receipt of a submission, the Employer shall, within the period shown in the submittals schedule, return either:

i) an Advice of No Objection, or

ii) if the Employer objects to, or requires further clarification to a design, a statement of objections that identify the reasons for such objection.

5.7.12 The Employer may object to submissions on the ground that they either:

i) do not comply with the Contract, or

ii) are not consistent with or have not been properly integrated into the works of the Civil Infrastructure Contractors or Designated Contractors, or

iii) do not comply with generally accepted engineering practice, or

iv) would, if built, be an unacceptable risk to public safety, or

v) would, if built, cause unacceptable damage to the environment.

5.7.13 Upon notification of the Employer's objection to a submission, the Contractor shall, in accordance with the requirements of the Contract, make appropriate corrections and resubmit the submission for approval.

5.8 Manufacture, Construction and Installation

5.8.1 The Contractor shall not proceed with the manufacture, construction or installation of any work contained within a design submission unless and until an Advice of No Objection has been issued against:

a) a Design Verification submission for works of manufacture; or where appropriate.

b) a Design Engineering submission for works of installation.

5.8.2 Where an Advice of No Objection has been issued by the Employer with comments, the Contractor may proceed with manufacture and/or installation prior to resubmitting the design submission provided that the Employer's comments are incorporated in such work.

5.8.3 Where a design submission is returned with an objection from the Employer, the Contractor may proceed at his own risk with those elements of the work relating to the submission which are not in the Contractor's opinion affected by the Employer's reasons for objection prior to resubmitting the design submission.

5.9 Drawing Standards

5.9.1 All drawings shall be accurate, to scale and be fully dimensioned.

5.9.2 The Contractor shall not rely on scaling for any dimension.

5.9.3 A logical drawing numbering and reference system shall be devised and used for all drawings.

5.9.4 All drawings shall be submitted in a standard format to be agreed with the Employer.

5.10 Mock-Ups

5.10.1 The Contractor shall construct mock-ups, if required to demonstrate to the Employer's satisfaction that the designs of these elements will fulfill the requirements of the Contract

5.11 Samples

5.11.1 In addition to any special provisions in the Contract for the sampling and testing of materials, the Contractor shall submit, in response to the request of the Employer, samples of any materials or fittings which the Contractor proposes to use in the Works.

5.11.2 Such samples, if approved, shall be retained by the Employer for the duration of the Contract and no materials or goods of which samples have been submitted shall be used in the Works unless and until such samples shall have been approved in writing by the Employer.

5.11.3 The Employer may reject any materials and goods, which in its opinion are inferior to the samples previously approved and the Contractor shall promptly remove such materials and goods from the Site.

5.12 As Constructed Documentation

5.12.1 The Contractor shall maintain all records necessary for the preparation of As Constructed Documentation.

5.12.2 Upon completion of the Works the Contractor shall prepare drawings and other documentation that, subject to the Employer's agreement, shall become the As Constructed Documentation.

5.12.3 The Contractor and the Employer shall agree on the number of copies of all drawings that shall be submitted as part of the As Constructed Documentation.

5.12.4 CAD files in electronic format of all drawings produced using CAD software shall also be submitted.

5.12.5 Where AutoCAD or MicroStation are not used, the Contractor shall provide two licensed copies of the applicable software to enable the Employer to access all As Constructed Documentation.

5.12.6 As installed software programmes, source code and associated documentation shall be considered to be an essential component of the As Constructed Documentation and shall be provided in three soft copies.

5.12.7 The software provided together with the associated documentation shall be sufficient for the Employer to restore the software to a fully functional state in the event of a recovery process being required following a storage device failure.

5.12.8 The Contractor shall provide specific applications program source codes and documentation required for the adjustment or calibration of system operations and maintenance routines and/or parameters.

5.12.9 Alternative programming or calibration tools and associated documentation as appropriate shall be provided in the event that source code can not be provided as a result of intellectual property constraints..

5.12.10 All As Constructed Documentation shall be endorsed by the Contractor as true records of the construction of the Works.

6 SOFTWARE MANAGEMENT AND CONTROL

6.1 Prescriptive Framework

6.1.1 The Contractor shall, within sixty (60) days of Notice to Proceed, submit a Software Quality Assurance Plan for review by the Employer.

6.1.2 All software to be developed or modified (re-engineered software) shall follow the standardisation requirements of EN 50128 (Railway Applications: Software of Railway Control and Protection SystemsThe Contractor shall define within the Software Quality Assurance Plan what techniques and measures have been applied for software development. The Software development and management shall comply with the System Software Assurance document to be prepared by the Contractor. The Software development and management shall comply with the Software Requirements document forming part of the Contract.

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

6.1.4 The Contractor shall provide all tools, Laptop computers or any special device to upload/ download the software, data logs, equipment, manuals and training necessary for the Employer to maintain and re-configure all software provided under this Contract. The documentation of software may be supplied after the expiry of the warranty period, under terms and conditions acceptable to the Employer.

6.1.5 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 Employer, full details, in writing, as to the nature of the corrective action proposed or taken. These changes shall be documented in the form of Software Engineering Change Proposal (SECP), which shall be subject to approval by the Employer. The documentation of software may be supplied after the expiry of the warranty period, under terms and conditions acceptable to the Employer.

6.1.6 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 EN 50128, all software produced or supplied for the Project shall be subject to a defined quality framework. 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.

6.3 Software Management Control

6.3.1 The Contractor shall ensure a full time Software Project Manager and Software Quality Manager are appointed for software development, if software development or modification are required under the Contract.

6.4 Auditing

6.4.1 The Employer shall carry out Software audits. Further external independent audits may also be arranged at the Employer's discretion.

6.5 Software Acceptance

6.5.1 The Contractor also shall submit an Operational Safety Report (Software) for software acceptance by the Employer. The Operational Safety Report (Software) shall include, as a minimum

(i) OSR(S) - Introduction

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

(ii) OSR(S) - Evidence of Quality Management

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

(iii) OSR(S) - Evidence of Safety Management

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

(iv) OSR(S) - Technical Report

Shall describe how software integrity has been achieved.

(v) OSR(S) Operation and Maintenance Report

Shall describe the Software operation and maintenance characteristics.

(vi) OSR(S) - Restrictions for Use

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

6.6 Availability Of Source Code And Development Tools

6.6.1 With the exception of commercial, "Off The Self" Software, the Employer shall be provided with access to full software documentation including source code listings and development tool details. For such commercial software the Contractor shall provide all available documentation for the application and maintenance of that software. The documentation of software may be supplied after the expiry of the warranty period, under terms and conditions acceptable to the Employer.

6.6.2 After loading, and the satisfactory functioning of the software, the Contractor shall supply two back-up copies of the software, including any new versions adopted. The documentation of software may be supplied after the expiry of the warranty period, under terms and conditions acceptable to the Employer.

6.7 Re-Use of Existing Software

6.7.1 Where existing software (defined to module level) is to be re-used without modification, the Contractor shall provide acceptable evidence to the Employer as to why that software is suitable for use in the proposed application. This evidence may be historical (certified evidence of previous satisfactory use in a similar environment and application), or it may be sought as cross acceptance from another railway authority or statutory body. Software re-use shall not be acceptable, without detailed review, where the proposed application is of the same or lower safety integrity level than the current application.

6.8 Re-Engineered Software

6.8.1 Re-engineered software may be used for applications at all safety integrity levels where the proposed application is of the same or lower safety integrity level than the current application. However, this shall be subject to quality assurance testing as defined above.

6.9 Test Software

6.9.1 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 duration of the Contract. All test software shall be documented to be supportive of maintenance. Any test software, which 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.

6.10 Software Rights

6.10.1 The Contractor shall ensure that the Employer or its licensee 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 or its licensee from modifying or adopting or extending the system. The documentation of software may be supplied after the expiry of the warranty period, under terms and conditions to be mutually agreed at Contract pre-award stage. The Contractor shall indemnify the Employer, its heir or Licensees against claim of any party, sub-contractor for the unauthorised possession or use of the software supplied.

7 INSPECTION, TESTING AND COMMISSIONING

7.1 General Requirements

7.1.1 All materials, goods, equipment and manufacturing processes for the Works shall be subject to inspection and the witnessing of tests in accordance with the Conditions of Contract and as stated in this Clause.

7.1.2 The Contractor shall perform all inspections and tests applicable to the Works and as required by the Technical Specification.

7.1.3 The Contractor shall provide all associated documentary records of completed tests.

7.1.4 The Contractor shall give the Employer a minimum of fifteeen (15) days notice in writing of all requested inspections and tests giving details of the exact date, time and place of inspections and tests as well as other necessary information.

7.1.5 The inspections and tests shall be divided into stages as follows:

a) Type Testing or Qualification Test including shock and vibration testing;

b) Factory Acceptance Tests carried out before shipping of equipment;

c) On-Site Testing including static and dynamic testing;

d) Tests on completion of construction and before entering service shall be carried out in accordance with IEC 61133.

e) Integrated Testing and Commissioning;

f) Trial Running;

g) Official review by the KMRC and the Safety Commissioner; and.

h) RAMS Demonstrations.

7.1.6 Unless agreed in writing by the Employer, key personnel engaged on testing shall be qualified and independent of those directly engaged in the design or installation of the same equipment.

7.1.7 The inspection and passing of work or equipment by the Employer shall not relieve the Contractor from its obligations, responsibilities and liabilities to complete the Works in accordance with the Contract nor relieve it of any of its obligations responsibilities and liabilities under the Contract.

7.2 Test Plan

7.2.1 Within one hundred and twenty (120) days of the Commencement Date, the Contractor shall present for the approval of the Employer the Inspection, Test and Commissioning Plan showing in as much detail as available the tests anticipated to ensure a safe and reliable operation of the Works and the integration of the Works with the rest of the Kolkata Metro East West Line together with an indication of the periods in which the various stages of testing will be carried out.

7.2.2 The preliminary test plan shall include lists of all anticipated type tests, factory acceptance tests, on site tests and Tests on Substantial Completion (prior to Integrated Testing and Commissioning and Trial Running) required for commissioning of the Project.

7.2.3 Within ninety (90) days of the approval of the Inspection, Test and Commissioning Plan, the Contractor shall prepare and submit for the approval of the Employer the Test Plan which shall incorporate the comments of the Employer on the Inspection, Test and Commissioning Plan and shall be updated to reflect all changes in proposed scope and timing of inspections and tests.

7.2.4 The Test Plan shall:

a) identify the date on which the Contractor proposes to conduct each of these listed tests;

b) describe the nature and purpose of each test;

c) state the location at which the test is to be conducted;

d) identify the interfaces with the Rolling Stock Contractor, the Civil Infrastructure Contractors and all Designated Contractors that will require their attendance and/or support; and

e) identify the Contractor's requirements for the Employer’s staff to operate equipment during Integrated System Testing and Trial Running.

7.2.5 The Test Plan shall also include commissioning plans which shall include but not be limited to the following:

a) subsystem testing schedule;

b) integrated system testing schedule;

c) integrated system testing operating staff requirements;

d) Trial Running schedule;

e) requirements for staff recruitment and training; and

f) safety and security deployment and safe notice and/or training for all participants.

7.2.6 The Test Plan shall be updated by the Contractor at intervals not exceeding three (3) months to reflect progress and any change in the number, location or timing of the remaining tests.

7.2.7 The Test Plan shall be subject to review and comment by the Safety Commissioner and any additional tests and/or trials specifically ordered by the Safety Commissioner shall also be carried out by the Contractor.

7.3 Test Procedures

7.3.1 All test procedures shall be submitted for the approval of the Employer at least 45 days prior to conducting any test together with the anticipated time and date of such test.

7.3.2 Test procedures shall show unambiguously:

a) the extent of testing covered by each submission;

b) the method of testing and test requirements;

c) the relevant drawing (or modification) status,

d) the location of testing;

e) the safety management during test;

f) test personnel qualification requirement;

g) test parameters to be measured;

h) constraints to be applied during the test;

i) defined pass/fail criteria;

j) format of the raw data for processing by the Contractor;

k) certificated test instrumentation and test circuitry to be used during the test;

l) pro-forms to facilitate easy manual handwritten entries during the execution of the tests; and

m) consequential procedure or action when test is failed.

7.3.3 Test procedures shall be amended during the duration of the Contract to reflect changes in design or the identification of additional testing requirements.

7.3.4 The Contractor is reminded that, at some point, the power system will be energised and that additional precautions for the safety of staff and co-ordination of activities after power-on shall be anticipated in its installation, testing and commissioning programme.

7.3.5 No part of the power system shall be energised without the prior written agreement of the Employer.

7.4 Costs of Testing

7.4.1 All costs associated with testing up to commencement of Trial Running, shall be borne by the Contractor, including the services of any specialised personnel or independent assessors

7.4.2 Should an agreed test not be feasible as proposed due to lack of preparation, negligence or material and/or equipment being presented in a state which is clearly not acceptable, all costs incurred by the Employer for repeated inspections and/or witnessing shall be borne by the Contractor.

7.4.3 For tests outside India, the contractor shall be responsible for cost of travelling and accommodation incurred by the Employer and / or authorised representative based on 4 trips of 3 persons for 7 days each.

7.5 Equipment for Testing

7.5.1 Equipment, apparatus and materials for in situ tests and laboratory compliance tests shall be provided by the Contractor.

7.5.2 The equipment and apparatus shall be properly maintained by qualified staff and shall be calibrated before testing starts and at regular intervals as agreed by the Employer.

7.5.3 The equipment, apparatus and materials for in situ tests shall be removed by the Contractor as soon as practicable after testing is complete.

7.5.4 All test equipment shall carry an appropriate and valid calibration label.

7.5.5 The copy of certification report of test equipment shall be attached with test reports.

7.6 Use of Outside Laboratory

7.6.1 The Contractor shall be responsible for all on-site and off-site testing and for all in situ testing.

7.6.2 All appropriate laboratory tests shall be carried out in laboratories selected by the Contractor provided that they are accredited for the relevant work to a standard acceptable to the Employer and Technicals of the proposed laboratory are submitted to, and approved by, the Employer.

7.7 The Employer's Option to Attend Tests

7.7.1 The Employer has the option to attend or otherwise any scheduled tests.

7.7.2 If the Employer does not attend the tests, the Contractor shall carry out the inspection and tests, without the presence of the Employer and such inspection and tests shall be deemed to have been carried out in the Employer's presence and the Contractor shall forthwith forward to the Employer the copies of the inspection and test readings.

7.7.3 The Employer shall have the option to request a repeat test at his cost in accordance with the Conditions of Contract.

7.7.4 The Contractor shall with respect to the manufactured equipment proceed with the shipment of the same upon satisfactory completion of the inspections and the tests.

7.8 Records Of Tests

7.8.1 Within 30 days after completion of any individual test, all necessary information regarding the test shall be submitted in a report for the Employer’s review.

7.8.2 When the test procedure is such that a manuscript copy of the test record is made at the time of the test, a copy shall be given to the Employer at the time or at the earliest opportunity if the test has not been witnessed.

7.8.3 On completion of each test or group of tests, the Contractor shall provide a test report detailing:

a) the numbers and types of tests which are required by the Specification and the results to be achieved;

b) the tests actually carried out and the results actually achieved; and

c) confirmation of pass and failure with if necessary a schedule of further tests or actions to be carried out by the Contractor to achieve compliance with the Specification and the Approved design documents.

7.8.4 In addition to any other requirements, the test report and its supporting documentation held by the Contractor for the Employer's inspection and audit shall contain the following details:

a) material or part of the Works tested;

b) location and size of the batch from which the samples were taken or the location of the part of the Works;

c) reference to test procedures and test schedules;

d) place of testing;

e) date and time of tests;

f) weather conditions in the case of on site tests;

g) technical personnel supervising and/or carrying out the tests with their signatures

h) interface partners providing attendance and/or witnessing the tests with their signatures;

i) properties tested;

j) use of test equipment with copy of its certification report;

k) method of testing;

l) readings and measurements taken during the tests;

m) test results, including any calculations and graphs;

n) specified acceptance criteria;

o) action when test is failed; and

p) other details required by the Contract.

7.8.5 All reports of tests shall be signed by the Contractor and shall include copies of the actual handwritten results using the pro-forms from the test procedures.

7.8.6 Subsequent computer entry of previously handwritten results will not be acceptable. Computer generated data will only be permitted where automatic data logging has been necessary to carry out the test and required in the test procedure.

7.8.7 If the Employer disagrees with the content of any records and reports, the Employer shall notify the Contractor in writing of such disagreement within 28 days from the date of receipt of the testing data and any associated analytical reports.

7.8.8 In the absence of any notification to the contrary within the period stated above, the Employer shall be deemed to have agreed with the reports.

7.8.9 In the event that the Employer and the Contractor are unable to resolve a disagreement regarding the content of any record or report, the Employer and the Contractor shall appoint an independent party to submit a report on the quality of Plant.

7.8.10 This appointment shall be the subject of prior mutual agreement by the Employer and the Contractor.

7.8.11 The cost relative to the agreement of such independent party shall be borne by the Contractor if the quality of the Plant is found not to be in accordance with the conditions of this Contract; otherwise, such costs shall be borne by the Employer.

7.8.12 The test report, issued by the independent party, shall be final, for the purpose of this Contract.

7.8.13 If it is found as a result of inspection records and test reports issued by the Contractor or by agreement between the parties to this Contract or by independent technical advisers engaged as aforesaid, that the quality of the Works is not in conformity with the standards stipulated in this Contract, then the Contractor shall undertake remedial or corrective actions regarding the Works.

7.8.14 Approval by the Employer of tests, inspections and related procedures shall in no way relieve the Contractor of his contractual obligations.

7.9 Inspection and/or Witnessing of Tests during Manufacture and Assembly

7.9.1 The Contractor shall provide access for the Employer and/or nominated representatives to monitor all tests and have access to all test records.

7.9.2 Ample time shall be allowed within the test plan for necessary alterations to equipment, systems and designs to be undertaken, together with re-testing prior to final commissioning.

7.9.3 Unless agreed otherwise in writing by the Employer, all tests shall be carried out by the Contractor in the presence of the Employer and/or nominated representatives.

7.9.4 The Employer and/or its nominated representatives shall have the right and facility to inspect any or all of the equipment during the manufacture and assembly period.

7.9.5 The Employer shall provide adequate notice for such inspections and access shall not be unreasonably refused.

7.9.6 The Employer and/or its nominated representatives shall have the right to request the Contractor to perform additional test item where the results of test is unsatisfactory, incomplete, corrupted, inconclusive or demonstrate that the equipment or system under test failed to meet the requirements which is the subject of the test during his inspection and/or witnessing period.

7.9.7 In accordance with the results, if necessary, the Contractor shall modify the relevant design, manufacturing and test procedure for consequential works.

7.10 Type Tests or Qualification Test

7.10.1 Should the Contract include any equipment or function which is not previously proven in service the Contractor shall undertake the thorough type testing of pre-production units to the satisfaction of the Employer.

7.10.2 The Contractor shall identify in its design submissions any equipment or function in this category, or equipment that differs significantly from that already in service elsewhere.

7.10.3 Type tests shall be carried out on specific items to ensure that they perform their intended functions when subjected to all permutations and combinations of external conditions as defined in their design criteria.

7.10.4 Type testing for specific items may be omitted where the Contractor is able to produce adequate and certificated documentation from previous tests that meets the requirements of the Employer

7.11 Factory Acceptance Tests

7.11.1 All materials, components, sub-assemblies, unit assemblies (including software, cables and wiring) shall be subject to factory acceptance tests.

7.11.2 Notification of these tests shall be submitted to and as requested by the Employer thirty (30) days in advance of carrying out any test together with information on any previous testing which relates to the items being tested.

7.11.3 The Employer will then determine whether to witness such tests or which, if any, items may be accepted based on previous supply or experience.

7.11.4 Factory acceptance tests shall be comprehensive tests to verify that the manufactured equipment fulfils the Contract requirements, including but not be limited to:

a) physical inspection;

b) dimension check;

c) electrical check;

d) calibration;

e) interface check including input, output and protocol when necessary; and

f) operational performance including full functional testing to the Approved design documents.

7.11.5 Where processor based test equipment and/or simulator is to be used, tests shall also include verification of the software used.

7.12 On Site Testing

7.12.1 During and on completion of installation, the Contractor shall undertake on site testing of all cables, wiring and equipment including associated instrumentation and protection devices in a progressive sequence and in accordance with the overall testing programme.

7.12.2 These tests shall culminate in sub-system and combined systems functional tests to verify the correct operation of all apparatus and, where appropriate, correct response to the respective control commands or monitored function.

7.12.3 Not used

7.12.4 All on site testing is to be carried out under the overall supervision and control of the Employer.

7.12.5 The Contractor shall provide the Employer with all details of its test requirements for the testing of the Works. The Employer will assist the Contractor in coordinating these requirements with the other contractors.

7.12.6 Should a defect be found in the Works during one of the tests, the nature of the defect shall be explained in detail to the Employer.

7.12.7 On the basis of this information, the Employer shall decide if the defect is a Minor Fault, or if it must be rectified before testing can continue.

7.12.8 Minor Faults that are found during testing, but which do not adversely affect the operation of the system, need not be rectified before the test may continue and be successfully completed.

7.12.9 If the defect is not a Minor Fault, the Employer shall decide what portion of the test or tests must be re-run.

7.12.10 The Employer shall have the right to require all tests to be re-run if he decides that the defect has serious consequences.

7.12.11 All time spent initially on a test, or tests, or a part of a test which forms part of the Works and is re-run shall not be considered test time and the expenses arising from this re-running shall be borne by the Contractor.

7.12.12 The Employer shall inform the Contractor in writing of the Minor Faults found and which of these Minor Faults must be rectified, prior to accepting the installation and testing as being fully and satisfactorily completed.

7.12.13 Following completion of these tests to the satisfaction of the Employer, the Contractor shall prepare the Works for Integrated Testing and Commissioning..

7.13 Integrated Testing and Commissioning

7.13.1 The Contractor, in conjunction with the Rolling Stock Contractor, the Civil Infrastructure Contractors and all Designated Contractors, shall submit to the Employer for approval, the requirements and procedures for Integrated System Testing.

7.13.2 These tests are to clearly demonstrate that the completed Works are fully operational, meet the specified performance criteria, function in a coordinated and integrated manner with each other and with the works provided by the Rolling Stock Contractor, the Civil Infrastructure Contractors and all Designated Contractors and operate without any adverse effects on the surrounding environment.

7.13.3 The conduct of these Integrated System Tests shall include a period of test running.

7.13.4 Integrated System Testing shall begin after complete subsystem testing has been carried out on all subsystems and defects found have been rectified to the satisfaction of the Employer.

7.13.5 The Contractor shall prepare and submit to the Employer for approval the procedures it proposes to adopt to test the interfaces and compatibilities between all subsystems.

7.13.6 In particular, Integrated System Testing shall include tests to demonstrate train reversing with minimum practical headways and to demonstrate the operational performance of the Works under worst case conditions.

7.13.7 The Integrated System Testing period shall include sufficient time to rectify and re-test any problem areas discovered without diminishing the time allowed for Trial Running.

7.14 Trial Running

7.14.1 Following completion of Integrated System Testing to the satisfaction of the Employer and after all major defects found during the tests have been rectified to the satisfaction of the Employer, the Contractor, assisted by the Operator and Maintainer, shall commence a three months period of Trial Running to demonstrate that the System can operate safely and reliably under simulated revenue service conditions.

7.14.2 During these tests the Contractor, assisted by the Operator shall demonstrate that all procedures for normal, degraded and emergency operations and maintenance activities perform as expected with respect to the Works.

7.14.3 Trial Running shall include but not be limited to the following elements.

a) The operation of a range of timetables up to and including a full complement of trains as required for maximum scheduled service, including periods of peak demand and periods of maintenance.

b) The intentional disruption of the service including simulation of a wide range of technical failures such as various vehicle failures, power systems outage, ATP failure, ATO failure, communication systems failures, point failure and train detection failures in order to check operational stability, the safety of the System and the effectiveness of technical back up facilities and degraded operating procedures.

c) The intentional disruption of the service including simulation of a range of non-technical events such as extended dwell times, unavailability of staff (absent or unfit for duty on booking on) and station overcrowding in order to check operational stability, the safety of the System and the effectiveness of technical back up facilities and degraded operating procedures.

d) The simulation of emergency scenarios such as derailment of a train, fire in a station, security incident etc in order to check the effectiveness of incident response procedures technical back up facilities and emergency operating procedures.

e) Periods of simulated revenue service with no deliberate disruption to demonstrate system reliability and stability of the service under normal operating conditions.

f) The determination of the actual headway achieved at each station for all specified routes, including intermediate reversing movements and movements into and out of the Depot.

7.14.4 Should any deficiency be found during the evaluation of any of the tests, the nature of the deficiency shall be explained in detail to the Employer.

7.14.5 On the basis of this information, the Employer shall decide if the deficiency is a minor problem, which does not adversely affect the operation of the System, or if it must be rectified before trial running simulations can continue.

7.14.6 Deficiencies in the equipment comprising the Works including their effectiveness when used according to agreed procedures shall be corrected by the Contractor at no cost to the Employer.

7.14.7 If the deficiency is not a minor problem, the Employer shall decide what portion of the trial running simulations must be re-run.

7.14.8 The Employer shall have the right to require all simulations to be re-run if it decides that the deficiency has serious consequences.

7.14.9 All time spent initially on a simulation, or simulations, or a part of a simulation which is re-run shall not be considered as part of the Trial Running period and the expenses arising from this re-running shall be borne by the Contractor.

7.14.10 The Employer shall inform the Contractor in writing of the minor faults found and which of these minor faults must be rectified prior to accepting the installation and testing and trial running period as being fully and satisfactorily completed.

7.14.11 The Trial Running shall be considered as successful if responses to simulated fault conditions and other disruptions including emergency scenarios have been evaluated satisfactorily and the System has been operated in simulated revenue service for a three month period during which time the availability of the Works shall be shown to have achieved or be approaching the targets defined in the Contractor's approved RAM studies

7.14.12 The Contractor shall allow for attendance over the whole of this period, which may be expected to include maintenance and repair activities and also further opportunity for technical staff training.

7.14.13 The Contractor shall provide all necessary support to the Employer relating to the Works and its interfaces to other elements of the Kolkata Metro East West Line to assist the Employer throughout the inspection and in gaining the approval of the KMRC and/or the Safety Commissioner.

7.15 Completion of Testing

7.15.1 Upon successful completion of the integrated System Testing and Trial Running, the Contractor shall apply for the Taking Over Certificate in accordance with the Conditions of Contract.

7.15.2 Upon successful completion of the RAMS demonstration , the Contractor shall apply for the inspection and release on work completion and acceptance certificate in accordance with the Conditions of Contract.

7.16 RAMS Demonstrations

7.16.1 The Contractor shall demonstrate full compliance with the Contract requirements relating to the Reliability, Availability, Maintainability and Safety.

7.16.2 The requirements relating to Maintainability and Safety shall be demonstrated before the commencement of Trial Running and may begin as soon as the necessary systems or elements of systems have been tested and commissioned.

7.16.3 It is unlikely that the requirements relating to Reliability and Availability can be fully demonstrated before the commencement of Trial Running and these shall therefore be fully demonstrated throughout Trial Running Period and the Warranty period.

7.16.4 In conjunction with approved System Safety Plan, the Contractor shall develop demonstration plans and submit for the Employer's approval.

7.16.5 Demonstration plans shall include, but not be limited to, the following::

a) demonstration schedule and period;

b) identification of necessary facility, resources, support equipment, staffs of Operator and coordination items;

c) administration and control during the period;

d) description of philosophy, policy, methodology and pass/fail criteria;

e) detail of procedures, data format to collect and analysis; and

f) final conclusion and report for the demonstration.

8 SUPPLY OF SPARES, SPECIAL TOOLS AND TESTING EQUIPMENT

8.1 Definition of Spare Parts and Consumables

8.1.1 Consumables means all parts that have a known, short life expectancy (such as lubricating oil, brake pads, filters, lamps and fuses) where the used item is discarded after replacement.

8.1.2 Spares means all parts that fail in a random manner where the failed item may be either repaired and returned to stock or replaced by a new spare that will go into stock. Mandatory Spares and Recommended Spares fall into this category

8.1.3 It should be noted that some consumables are also subject to random failure and sufficient quantities shall be provided to cover both predicted replacements (consumables) and random failures (spare parts).

8.1.4 Spare parts also includes “emergency spares” for items where no failures are predicted in the lifetime of the system but which may be rendered unusable through accidental damage or other external influence and where such failure would seriously impact the operation of the system in revenue service.

8.2 NOT USED

8.3 NOT USED

8.4 NOT USED

8.5 NOT USED

8.6 NOT USED

8.7 NOT USED

8.8 NOT USED

8.9 NOT USED

8.10 List of Spares

8.10.1 The Contractor shall ensure availability of spare parts for 10 years. The Contractor shall furnish an unpriced list of spares for maintenance and repair of works separately (If there are difference in item) for a period of ten (10) years from te date of completion of DLP.

8.10.2 If at any time during the thirty five (35) year design life, the Contractor intends to discontinue the manufacture of spare or replacement parts for the Works, the Contractor shall immediately give notice to the Employer of such intention. The Employer shall be given the opportunity of ordering at reasonable prices such quantities of such spare or replacement parts as the Employer shall reasonably require in relation to the anticipated life of the Works.

8.10.3 In the event of Contractor failing to supply the spare parts or failing to arrange supply of the spare parts in accordance with this Clause, he shall in respect of each item of spare, furnish free of cost to the Employer, the drawings, specifications, patterns and other information to enable the Employer to make or have made such spare parts. The Employer shall be entitled

to retain the aforesaid drawings etc., for such time only as is necessary for the exercise by the Employer of his rights under this clause and the drawings, if the Contractor so requires, shall be returned by the Employer to the Contractor in good order and condition (fair wear and tear excepted).

8.10.4 Under such circumstances, the Contractor shall also grant to the Employer, without payment of any royalty or charge, full right and liberty to make or have made spare or replacement parts as aforesaid and for such purposes only to use, make and have made copies of all drawings, patterns, specifications and other information supplied by the Contractor to the Employer pursuant to the Contract.

8.10.5 The Contractor will bind his sub-contractors to conform with the requirements of this Clause and shall, prior to entry into any sub-contracts, provide the Employer with full details of any sub-contractor who will not so conform in which event the Employer may direct the Contractor to seek an alternative sub-contractor.

8.10.6 If the Contractor fails to provide spare or replacement parts as described in this Sub-clause and these are available from the Contractor's sub-contractor, the Employer shall have the right to obtain such spare and replacement parts from the sub-contractor or any other supplier.

8.10.7 In case the Contractor is unable to supply spares in accordance with Clause above, he shall furnish, free of cost to the Employer, the drawings, specifications, and other technical details, to enable the Employer to manufacture parts, or have them manufactured. Such drawings and technical data shall be provided free of any charge or royalty, on the understanding that the Employer will use such data and drawings, only for the manufacture of parts for his own use.

8.10.8 The foregoing shall hold equally good for the Contractor, any or all of his sub- contractors, and vendors.

8.10.9 In the event that technological progress results in improved versions of spares and replacement parts, the latest version shall have the same plug compatibility, and spatial needs of its predecessor, to avoid modifications being required, to accept the up-graded version of the part.

8.11 Quantities of Spare Parts and Consumables

8.11.1 The Contractor shall calculate quantities and submit evidence of the sufficiency of these quantities for consumables and spares based on either service history or theoretical predictions using established techniques of component or system failure rates (MTBFs).

8.11.2 The calculated quantities to be provided shall also take into account the minimum order quantities and the lead times.

8.11.3 The Contractor shall make recommendations for minimum stock holdings and reorder quantities for all spare parts and consumables and shall specifically identify to the Employer any spare parts or consumables that may be subject to long production times or high quantities for production and will require special attention for future procurement.

8.11.4 The Contactor shall identify to the Employer any spare parts or consumables that can be subject to be supplied from secondary certificated supplier for future procurement by the Employer.

9 TRAINING

9.1 Scope of Training

9.1.1 The Contractor shall provide comprehensive training to key members of the Employer's personnel who will be involved either directly or in training others in the operation and maintenance of the Kolkata Metro East West Line.

9.1.2 The Contractor shall prepare a training programme and materials for operations personnel, together with their associated supervision and management personnel and maintenance / engineering personnel.

9.1.3 The Contractor shall provide suitably qualified and competent instructors.

9.1.4 The Contractor shall make available for training purposes such training aids and equipment as may be necessary to carry out practical training before the Kolkata Metro East West Line is commissioned and put into service.

9.2 Training Plan

9.2.1 Within six months of the Commencement Date the Contractor shall resubmit the Tender Training Plan updated to provide a detailed explanation of the training philosophy, objectives and methodology for the Employer's personnel such that personnel on completion of training shall have the knowledge and/or skills required.

9.2.2 The Training Plan shall provide details of the timing and duration of all training activities including the preparatory phase.

9.2.3 The Training Plan shall be developed to include training plans for each group of staff to be trained detailing course modules, objectives, content, duration and the standards to be achieved.

9.2.4 For each course and or module the Contractor shall also provide schedules of training equipment and accommodation requirements

9.2.5 The Contractor shall schedule Operations and Maintenance training provided to the Employer such that all classroom and practical training in the operations and maintenance of the equipment and certification of staff can be completed by the Employer at least one month before the commissioning of the Kolkata Metro East West Line.

9.3 Training Requirements

9.3.1 The Contractor shall include in the Training Plan:

(i) Training of the Employer's operating personnel(off –shore 2 man-months / on-shore 5 man-months).

(ii) Training of the Employer's maintenance personnel (10 man months) in Contractors / sub-contractor's Works/OEM and Kolkata Metro East West Line off-shore.

(iii) Provision of Contractor's Instructors (2.5 man months) for Training of the Employer's operating personnel in India.

(iv) Provision of Contractors/OEM's Experts / Instructors (5 man months) for Training of the Employer's maintenance personnel in India.

(v) Submission of Training Manuals (Original plus five hard copies) and in Electronic format.

9.3.2 The travel, boarding and lodging expenses for the Employer's trainees will be borne by the Employer.

9.3.3 Facilities such as classrooms, overhead projectors, VCRs and video monitors will be made available for imparting training in India free of cost to the Contractor. However, for training in the Contractor's works, such facilities shall be arranged by the Contractor at his own cost. The Contractor is however, required to provide at his own cost all other necessary training aids such as written and printed notes, vide programmes, transparencies, slides, films, models and drawings, and other training aids etc.

9.3.4 The Employer's personnel required to undergo training will be qualified electrical, mechanical and electronics engineers, technicians, supervisors or instructors, with relevant practical experience. The training syllabus should therefore concentrate on familiarisation with particular systems and equipment comprising the Works and technologies outside of their experience.

9.3.5 Training Instructors provided by the Contractor shall be fully qualified and experienced electrical, mechanical and electronics engineers and experts in the relevant field with experience in training of engineering graduates and technicians to the level of competency essential for operation and maintenance of the equipment comprising the Works.. The Instructors shall be preferably English speaking. If any interpreter is required, it shall be arranged by the Contractor at his cost. The appointment of Instructors shall be confirmed only after their detailed curriculum vitae have been accepted by the Employer. In the event that an Instructor is subsequently deemed not to be competent, he shall be replaced forthwith.

9.4 Training Objectives: Operating Staff.

9.4.1 The objective of training control room staff is that they should be able to manage the operation of the using the facilities provided by the Contractor and to be able to impart their knowledge to line and depot controllers. The training should also enable them to acquire full capability for identification and troubleshooting of the faults in the specified duration.

9.4.2 The Contractor's Instructors deployed for training of operating Staff in India shall provide training in classroom, as well as actual operation of the equipment comprising the Works during and after commissioning in India. The instructors shall also train the operating staff in trouble shooting of the faults and emergency procedures.

9.5 Training Objectives - Maintenance Staff

9.5.1 The training should enable the engineers, inspectors and staff to achieve the following broad objectives:

(i) Full understanding of all aspects of the system design and functions of all the equipment including proprietary and third party equipment, software etc.

(ii) Full understanding of all aspects of programmed maintenance of equipment.

(iii) Procedures to be followed for unscheduled maintenance and repair of equipment comprising the Works.

(iv) Identification of failed components and sub-systems in electronic equipment by use of special test equipment, as necessary.

(v) Modification in the software to extend or modify the control and monitoring functions.

(vi) Maintenance Management Information System and documentation.

(vii) Stores inventory planning and control.

9.5.2 The training of the Employer's personnel off shore shall include direct exposure to engineers, technicians, inspectors and staff in actual repair and maintenance of the equipment comprising the Works in the Depots and Workshops of an operational Mass Rapid Transit System.

9.5.3 The Contractor's Instructors deputed to train the Employer's personnel in India shall impart theoretical as well as practical training so as to enable them to develop skill and expertise necessary for satisfactory maintenance and repairs of equipment comprising the Works.

9.6 Training Methods

9.6.1 As a general guide, training shall be based upon a "two-stage" concept:

9.6.2 Stage one shall consist of training in the basic concepts and principles. These shall include system configuration and specification, operation and control of all equipments comprising the works, preventive maintenance procedures and repair concepts, fault diagnostic and trouble shooting an emergency procedures. The training shall consist of class room (theory) training; computer based inter-active training and mock-up training.

9.6.3 Stage two shall consist of "hands-on" site-based practical training on preventive and corrective maintenance and operating procedures.

9.6.4 The Contractor shall also include the training of the staff in the correct procedures of maintenance and repair of different equipment based on the Training Manual supplied against the contract.

9.6.5 The Contractor shall arrange the experts from the OEMs of the systems to impart the "hands on" training at site for the agreed durations during the contract execution. Training evaluation shall be carried out at regular intervals to monitor the progress and suitability of the training programme, and of the trainees.

9.6.6 The performance of the Contractor's Instructors shall also be evaluated by the Employer at regular intervals.

The Contractor shall provide training courses suitable for operating and maintenance staff classified below :

(a) First line and second line maintenance staff undertaking recovery/ corrective and routine/preventive maintenance

(b) Third line(high level) maintenance staff undertaking workshop repair and overhaul of

the plant.

(c) Technical staff who will be involved in fault analysis, investigating techniques and any future reconfiguration of the plant concerned.

(d) Operating staff undertaking normal and degraded operaqtions of the plant.

9.7 Training Manual

9.7.1 The Contractor shall provide one original and five coloured copies of the Training Manual for use by the Employer for conducting in-house training. The Manuals shall cover all requirements specified in this General Specification.

9.8 Transfer of Training Aids

9.8.1 After completion of the training, training aids and materials used shall become the property of the Employer to enable further training to take place.

9.9 Training Location and Facilities

9.9.1 Training shall be carried out at such locations as will provide the maximum benefit to the trainees. Such locations may be in India, or abroad, at places of manufacture, assembly or testing, or at other locations as may be necessary. All locations proposed for training shall be subject to the consent of the Employer. Details of the facilities proposed to be provided, shall be included within the detailed Training Proposal submitted by the Contractor.

9.10 Administration

9.10.1 The Contractor shall be responsible for the reception, office facilities etc. for the trainees, when in countries other than India.

9.10.2 The Contractor shall be responsible for the general welfare, health and safety of trainees under his control.

9.11 Qualification and Certification

9.11.1 The Contractor shall submit details of qualification and certification requirements to the Employer prior to commencement of training as follows.

9.11.2 The standards of knowledge, skill and competence he considers the minimum necessary on completion of training courses or modules.

9.11.3 Proposals for competence assessment and procedures for retraining candidates who fail to reach the required standards.

9.11.4 Proposals for the issue to candidates of certificates in respect of those who are assessed as competent to undertake an activity.

9.12 Appreciation of Design, Manufacture and Commissioning

9.12.1 The Contractor shall be required to provide appreciation course for selected members of the Employer's staff.

9.12.2 The course shall be conducted in such a way as to allow an overall appreciation of the design, manufacture, installation, testing commissioning and, maintenance aspects of the Works.

9.12.3 The Contractor shall develop a programme in consultation with the Employer and submit the programme for the Employer's approval within 3 months of the Commencement Date.

9.12.4 The programme shall be on the subsystems basis of Kolkata Metro East West Line elements.

9.12.5 The objectives, content, method, location, timing and duration of the course shall be addressed in the programme.

9.12.6 The Contractor shall be responsible for the reception, hotel and travel arrangements for the Employer's personnel to partake in the off-shore course but the travel and accommodation expenses shall be borne by the Employer.

9.12.7 The Contractor shall arrange and provide all resources required to conduct on-shore course program to the Employer's personnel.

10 WORKS SITE

10.1 General

10.1.1 Subject to the provisions of the Conditions of Contract, the Contractor shall take all measures necessary to safeguard the health and welfare of the general public and all persons entitled to be upon the Site and shall ensure that the Works are carried out in a safe and efficient manner. Contractor to establish at own cost the site office/site container for Phase-II project with mandatory amenities like Computer, Printer, light, Air-conditioning, proper sitting arrangement etc. with subject to approval of Engineer/Employer.

10.1.2 The Contractor, its Sub-Contractors and all persons employed by it on the Site shall comply in every respect with the provisions of any relevant statutory regulations as may be considered applicable to the Works and with any specific site safety rules and procedures that may be issued from time-to-time by the Employer.

10.1.3 The timing, sequence and conditions relating to the Contractor's possession of the Site, Works Area or access to Works Areas in the possession of Civil Infrastructure Contractors and/or Designated Contractors are set out in the Conditions of Contract.

10.1.4 The Site or the Contractor's plant and equipment shall not be used by the Contractor for any purpose other than for the execution of the Works.

10.1.5 No sign boards, illuminated signs or advertising shall be displayed on the Site other than the Employer's signboards and the Contractor's sign boards, the number, location and size of which shall be subject to the approval of the Employer.

10.1.6 The particular use to which the Site is put shall be submitted to the Employer for review within 120 days of the Date of Notice to Proceed. The Contractor shall:

(i) confine his use of the areas of the Site to purposes having been reviewed without objection by the Employer who reserves the right to extend, amend or restrict the uses to which areas of the Site will be put;

(ii) where required under the Contract, provide and maintain fencing 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;

(iii) refrain from depositing rubbish or causing nuisance or permitting nuisance to be caused and, except where reviewed without objection by the Employer, depositing earth on or removing earth from areas of the Site;

(iv) 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 Employer.

(v) except where otherwise provided, not permit any person to reside on the site.

(vi) unless otherwise stated, 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.

(vii) not use any part of the Site or Works for advertising purposes except with the

acceptance of the Employer.

10.1.7 The Site shall be maintained in a clean and tidy condition. Materials, including those required for Temporary Works, shall be stored in an orderly manner. The Contractor shall, throughout the period of the Contract, provide a central collection point on Site, as reviewed without objection by the Employer, 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 Employer.

10.1.8 The Contractor shall ensure that gases, fuels, explosives and other dangerous goods are stored and handled in a safe manner and in accordance with the Statutory Regulations pertaining to their storage and handling. The Contractor shall be responsible for obtaining the requisite licences at his own cost.

10.1.9 The Contractor shall provide all necessary protective clothing, safety equipment, hand tools, ladders, trestles, power supply, and replacement equipment for the staff engaged on Site maintenance.

10.1.10 Because of the multi-disciplinary 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.

10.1.11 To facilitate the organisation and co-ordination of access and occupation requirements, the Contractor shall maintain a close liaison with other Contractors.

10.1.12 As soon as any or all of the Contractor's installations are no longer required for the execution of the Works, the Contractor shall remove those facilities and ensure that the area is left free of debris, excess materials, and obstructions.

10.1.13 All the provisions of this clause 10 shall be read in conjunction with the requirements in the Safety, Health and Environment document forming part of the Contract.

10.2 Access To The Site

10.2.1 Entry to and exit from the Site shall be controlled and shall be only available at the locations permitted by the Employer, in accordance with the requirements of this General Specification.

10.2.2 The Contractor shall make its own arrangements, subject to the consent of the Employer, for any further access required to the Site.

10.2.3 In addition, the Contractor shall ensure that access to every portion of the Site which is in its possession or to which it has access is continually available to the Employer.

10.2.4 The Contractor shall be responsible for ensuring that any access or egress to Works Areas in its possession or to areas to which it has access are controlled such that no disturbance to residents or damage to public or private property occurs as a result of the use of such access or egress by its employees.

10.3 Site Services

10.3.1 The Contractor shall, except for the attendances to be provided by Civil Infrastructure Contractors and/or Designated Contractors under this General Specification, be responsible for providing/arranging all site services and/or site attendance as necessary and appropriate (and for paying all costs and charges in connection therewith) for the execution of the Works, which shall include, without limitation: temporary electricity, water, telephone, drainage and sewage disposal.

10.3.2 Such services shall be provided by the Contractor for use solely in connection with the proper execution of the Works. The Contractor shall be responsible for complying with all regulations of the Relevant Authorities concerned.

10.3.3 The Contractor shall be responsible for the provision and maintenance of all installations associated with such services and in relation thereto and shall take all precautions to safeguard the safety and health of all persons and the security of the Site.

10.3.4 The Employer may demand the immediate disconnection or alteration of such installations or portions thereof as it considers being prejudicial to safety, health or security.

10.3.5 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 Employer.

10.3.6 All installations shall comply fully with all appropriate statutory requirements.

10.3.7 Pipes, tubes, ducts or cables crossing highways, footpaths, or rights of way shall be ramped over or recessed below the surface.

10.3.8 Reasonably lit access to the areas and to rail sidings will be provided by others. If lighting is not provided in the specific areas allocated to the Contractor, he should make his own arrangements. The Contractor shall be solely responsible for the security and housekeeping of the area, plant and possessions allocated to him. The Contractor shall provide and maintain all facilities required by him in the area allocated for his exclusive use and all other work required to allow the Contractor to fulfil his obligations under the Contract.

10.3.9 The Contractor shall arrange at his own cost all Site services necessary and appropriate for the assembly, testing and commissioning of trains, which shall include, but not necessarily be limited to:

i) Electricity at site area(other than traction and inside the shed);

ii) Compressed air other than the depot inspection shed;

iii) Communication facilities; and

iv) Instrumentation.

10.3.10 The Contractor shall be responsible for making applications or requests to the concerned Authorities for availing of the above facilities. In the event that electricity or water supplies are arranged by another Designated Contractor in the Depot area, the Contractor may avail himself of those supplies from the Designated Contractor, either directly on agreed terms and conditions. The Contractor shall comply with all regulations of the utility companies and Government departments concerned.

10.3.11 Maintenance equipment available at the depot shall be provided by the Employer for use by the Contractor duting testing and commissioning. The Employer shall provide the list of equipment to be made available at the Depot at a later date.

10.4 Temporary Buildings

10.4.1 The Contractor shall provide and maintain all necessary temporary buildings, (e.g. offices, workshops, ablutions, water closets, sheds, and stores) and storage areas, move as required during the execution of the Works and remove the same from the Site on completion of the Works.

10.4.2 No structure or storage area shall be erected or laid out by the Contractor within the Site without the Employer's consent but such consent shall not relieve the Contractor of the responsibility of siting temporary structures clear of the Works, utility access points and the like.

10.4.3 Copies of the plans showing the extent and position of all approved temporary buildings and storage areas shall be prepared by the Contractor and retained for inspection in the site offices, and copies shall be given to the Employer.

10.4.4 Temporary buildings and storage areas shall be regularly cleaned and maintained.

10.4.5 The Contractor shall provide efficient and sanitary latrine accommodation for the use of its employees on the Works and shall keep the whole of the Site and the latrines in a clean and sanitary condition to the satisfaction of the Employer.

10.4.6 Materials used for the construction of the offices shall be new and of good quality. Materials shall be chosen such that the buildings when erected shall give good temperature and sound insulation.

10.4.7 Windows to each room shall be of an area not less then 10% of the floor area. All the rooms shall be adequately ventilated. All windows to ground floor offices shall be fitted with burglar bars firmly attached to the structure of the building.

10.4.8 The Contractor shall also arrange for the constant and hygienic disposal of all effluent, sewage and rubbish from the buildings.

10.4.9 All buildings shall be supplied with electricity 240V 50Hz that shall be distributed to each room in accordance with the Regulations. Lighting and electrical power points shall be provided to each room.

10.4.10 Fire fighting equipment shall be provided in accordance with the recommendations of the Kolkata Fire Brigade.

10.4.11 The Contractor shall provide, erect and maintain appropriate name boards as specified for each of the offices.

10.5 Site Drainage

10.5.1 The Works, including materials for use in the Works, shall be protected from damage due to water.

10.5.2 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.

10.5.3 Silt and debris shall be removed by traps before the water is discharged and shall be disposed of at a location or locations approved by the Relevant Authorities.

10.5.4 The discharge points of the temporary pumping systems shall be as approved by the Employer.

10.5.5 The Contractor shall make all arrangements with and obtain the necessary approvals from the Relevant Authorities for discharging water to drains or watercourses.

10.5.6 The relevant work shall not start until the approved arrangements for disposal of the water have been implemented.

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

10.5.8 Measures shall be taken to prevent flotation of new and existing structures.

10.6 Protection of the Works, Damage and Interference

10.6.1 The Works shall be protected from damage that could arise from adjacent work.

10.6.2 The Works shall be carried out in such a manner that work carried out by others, including Civil Infrastructure Contractors, Designated Contractors and Relevant Authorities is not damaged.

10.6.3 Work shall be carried out in such a manner that other than to the extent that is necessary for them to be removed or diverted to permit the execution of the Works there is no damage to or interference with:

a) utilities;

b) structures, roads, including street furniture, or other property;

c) public or private vehicular or pedestrian access; and

d) watercourses or drainage systems.

10.6.4 The Contractor shall inform the Employer and the Relevant Authorities as soon as practicable of any items which are not stated in the Contract to be removed or diverted but which the Contractor considers need to be removed or diverted to enable the Works to be carried out; such items shall not be removed or diverted until the consent of the Employer and the Relevant Authorities to such removal or diversion has been obtained.

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

10.6.6 The Contractor shall immediately inform the Employer of any discovery of historic interest or excavation during the execution of the Works.

10.6.7 The Contractor shall take all necessary protection on making such a discovery.

10.6.8 The Contractor shall obey the requirements of the laws that relate to such circumstances and shall advise the Employer of any consequential Works.

10.6.9 The Contractor shall immediately inform the Employer and the Relevant Authorities of:

a) damage to utilities;

b) leakage of utilities;

c) discovery of utilities not previously identified; and

d) diversion, removal, repositioning or re-erection of utilities which is required to enable the work to be carried out.

10.6.10 The Contractor shall immediately inform the Employer of any damage to structures, roads or other property.

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

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

10.6.13 The Contractor shall provide, install and operate adequate wheel washing and inspection facilities adjacent to any access to any completed carriageway surfacing, and shall ensure that all vehicles are clean, in proper condition, properly loaded and secured prior to running on any public road.

10.6.14 Material shall not be banked around trees.

10.6.15 Trees shall be protected from damage at all times and shall not be trimmed or cut without prior advice to the Employer.

10.6.16 The Contractor shall not make use of public or private rights of way for depositing or storing plant or materials.

10.6.17 Plant and materials shall be placed in such a way as to cause minimum interference with the use of any right of way by the public.

10.7 Avoidance of Nuisance and Noise Due to the Works

10.7.1 The Contractor shall take all reasonable precautions and select appropriate tools, equipment and installation methods to avoid causing a nuisance arising from his operations and shall minimise inconvenience to the public.

10.7.2 The Contractor shall prevent dust from rising as a result of his activities.

10.7.3 All Contractor's Equipment used on the Contract shall be fitted with a means of suppressing radio and television interference and shall be operated and maintained in such manner so as to minimize the emission of smoke and obnoxious fumes.

10.8 Site Health and Site Safety

10.8.1 The Employer will issue to the Contractor the latest edition of the Employer's Project Safety Manual. The Contractor shall, as a minimum, comply with this Safety Manual. The Contractor shall, as a minimum, comply with this Document. However, this shall not relieve the Contractor of any of his statutory duties, obligations or responsibilities under the Contract. The Employer reserves the right to order the immediate removal and replacement of any item of Contractor's equipment, which is deemed to be in an unsafe condition.

10.8.2 The Contractor shall submit a Site Safety Plan, and also designate a member of his staff as Safety Officer.

10.8.3 The Contractor shall establish and maintain and staff at all times when personnel are on site, a First Aid Post. Portable First Aid Boxes shall be maintained in a fully equipped state at each site work centre. The Contractor shall ensure that at least one employee on every working shift, is a trained First Aider, capable of administering First Aid competently until the arrival of professional help, in an accident situation.

10.8.4 The Contractor shall be fully responsible for the safety of the Works, his personnel, his sub-contractors' personnel, the public, and any persons directly or indirectly associated with the Works, or on or in the vicinity of the depot site.

10.8.5 The Contractor shall treat safety measures as high priorities in all hi activities throughout the execution of the Works.

10.8.6 The Contractor shall submit to the Employer, regular Site Safety Reports, and shall notify immediately the occurrence of an accident involving his staff or that of his sub-Contractors, or to any person within the area of the depot for which the Contractor is responsible.

10.8.7 The Contractor shall comply with all safety and industrial health legislation including, without limitation, all applicable local rules and regulations.

10.8.8 In addition to all other actions which the Contractor may take to meet his obligations under the Contract he shall implement a safety enforcement programme to be administered under a qualified and experienced safety officer.

10.8.9 Details of the programme and résumé of the safety officer shall be submitted to the Employer for approval within 45 days of the Commencement Date.

10.8.10 The officer shall ensure that the Works are carried out in a safe manner and shall enforce all necessary site safety regulations.

10.8.11 The Contractor shall provide and enforce at all times the wearing of efficient safety helmets and work shoes and, where necessary, eye goggles, ear protectors, safety harnesses and other personal protection equipment for all personnel.

10.8.12 Fire Safety Regulations and other requirements pertaining to fire safety included in the Contract shall be observed at all times.

10.8.13 The Contractor shall ensure that all gases, fuels and other dangerous goods are stored and handled in a safe manner and in accordance with the statutory regulations pertaining to their storage and handling.

10.8.14 The Contractor shall be responsible for obtaining any requisite licences.

10.8.15 No operation involving ionising or electro-magnetic radiation shall be carried out without the approval of a safety officer.

10.8.16 The Contractor shall ensure that all personnel and members of the public are properly protected from the effects of any such radiation.

10.8.17 Each radiation area shall be conspicuously posted with appropriate signs and barriers.

10.8.18 The Contractor shall provide adequate stand-by generating plant, equipment and spares for illumination of the site of the Works to ensure the safety of personnel, the Works and the public.

10.8.19 The Contractor shall be solely responsible for ensuring the safety of all temporary electrical equipment on the Site.

10.8.20 Provision and maintenance of all temporary electrical installations and connection to the Public Supply shall be in accordance with the Statutory Undertakers regulations.

10.8.21 To the extent that the Contractor has access to Works Areas or other parts of the Site, the Site shall be maintained in a clean and tidy condition.

10.8.22 Materials shall be stored in an orderly manner. Rubbish and debris shall be disposed of daily.

10.8.23 Measures shall be taken to prevent mosquito breeding within Works Areas or areas to which the Contractor has access which shall include the following:

a) Empty cans, oil drums, packing and other receptacles which may retain water shall be deposited at a central collection point in accordance with the environmental regulations in force and shall be removed regularly; and

b) Standing water shall be treated at least once every week with an oil which shall prevent mosquito breeding.

10.8.24 The Contractor's plant and other items that may retain water shall be stored, covered or treated in such a manner that water shall not be retained.

10.8.25 Posters in Hindi, Bengali and English languages drawing attention to the dangers of permitting mosquito breeding shall be displayed prominently on the Site.

10.8.26 The provisions listed herein regarding safety shall apply to and be binding upon any Sub-Contractor employed by the Contractor for any part of the Works on the Site and the persons employed by such Sub-Contractor.

10.8.27 The Contractor shall ensure that proper and adequate provisions to this end are included in Sub-contracts placed by him.

10.9 Lifting Plant

10.9.1 The Contractor shall provide his own lifting facilities for unloading any heavy equipment, at the port of arrival, transhipment point, and depot.

10.9.2 The Contractor shall provide and maintain safe and sound mechanical cranes, hoists and conveying facilities when required for the lifting and transportation of materials.

10.9.3 All cranes, hoists and the like shall be fitted with overload warning devices.

10.9.4 All such equipment shall be regularly maintained in accordance with the manufacturer's recommended practices and standards having regard to any legislation or recommendations from the Statutory Undertakers.

10.9.5 Competent operators shall be provided for the control of all lifting and hoisting equipment.

10.9.6 Prior to its use on Site all lifting and hoisting equipment shall be tested to an approved safety margin and suitably identified in accordance with existing legislation.

10.9.7 The Safe Working Load shall be clearly and indelibly marked on all lifting equipment either by stamping or by the addition of permanently secured tag labels. Stamping shall not be permitted on any stress-bearing part.

10.9.8 The Contractor shall prepare and maintain an up-to-date register containing test certificates of all lifting and hoisting equipment used on the Works.

10.9.9 The register shall be available on Site from the commencement of construction for inspection by the Employer and any Statutory Undertakers and shall be entitled “Site Register of Approved Lifting Equipment”.

10.10 Security

10.10.1 The Contractor shall be responsible for the security of the Works Areas from the Access Date stated in the Conditions of Contract until handed back to the Employer, and shall also be responsible for the security of other Works Areas during such times and to the extent that the Contractor has access thereto.

10.10.2 The Contractor shall set up and operate a security system limiting access to authorised persons only.

10.10.3 To this end, the Contractor shall provide specific points at which entry can be effected, and shall provide gates and barriers at such points of entry and maintain at such gates and barriers security personnel and patrols as may be necessary, in the opinion of the Employer, to maintain security.

10.10.4 The Works Areas shall be fenced and gated for the duration of the Works to the satisfaction of the Employer.

10.10.5 During the execution of the Works, the Contractor shall maintain adequate security for the Works and the Works areas as may be necessary to protect the same. The Contractor shall coordinate and plan the security arrangements with the Desginated Contractors for the Works and the works of Designated Contractors having shared access to the Site or areas thereof.

10.10.6 In order to operate such a security system it will be necessary to put into place a system for the issue of unique passes to designated personnel of the Employer, Operator, Maintenance Contractor in addition to the Contractors personnel and vehicles entitled to be on the Site, which may need to be separately identifiable according to the shifts being worked on Site.

10.10.7 The Contractor shall at the outset determine, together with the Employer, a security system and the design of passes to suit the requirements of the foregoing and to suit the methods of working to be adopted by the Contractor.

10.10.8 The Contractor shall at all times ensure that the Employer has an up to date list of all persons in the direct or indirect employ of the Contractor who are entitled to be on the Site at any time.

10.10.9 The Contractor shall liaise with Designated Contractors and ensure that co-ordinated security procedures are operated, in particular in respect of vehicles permitted to pass through the site.

11 TRANSPORTATION TO SITE

11.1 General Requirements

11.1.1 The Contractor shall make all arrangements and assume full responsibility for transportation to the Site of all plant, equipment, materials and supplies needed for the proper execution of the Works. Procedures for access to and from the Site shall be co-ordinated with the relevant Authorities.

11.1.2 The Contractor shall use such routes and rights of entry to the Site as may be decided by the Employer from time to time. Routes for 'very large' or 'very heavy' loads shall be discussed with the Employer in advance and all arrangements thereafter shall be submitted to the Employer. 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.

11.1.3 The Contractor shall be responsible for obtaining permission from the Traffic Police and other relevant authorities for any transportation activities including movement of œvery large and œvery heavy loads and for arranging police escorts if required. 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 vehicle or its workmen, scaffolding, plant, materials, equipment, etc. All Workmen working on the road shall wear approved reflective safety vests at all times.

11.1.4 The Contractor shall comply with all the applicable requirements of the Motor Vehicle Act - 1988 and all other applicable laws. The Contractor shall ensure compliance with the requirements regarding the licensing of drivers and the registration of vehicles. Vehicle size and load limitations shall be in accordance with all statutory requirements.

11.1.5 The Contractor shall repair damage caused to roads, footpaths, steps, cables, sewers, drains, etc. and shall reinstate the same at his own expense to the satisfaction of the relevant authorities and shall indemnify the Employer.

11.2 Provision of inspection vehicle to Engineer & Employer

The Contractor shall provide 1 (One) Air-conditioned inspection vehicle having more than 2000 CC engine capacity including driver, fuel, lubricants and all incidental charges like taxes, insurances, etc. for inspection of Employers and Engineers official in Kolkata.

The duty hours for the vehicle will generally be 12 hrs (8 AM to 8 PM or otherwise directed by Employer) on all working days and holidays. The limit of travel of the vehicle shall be 2500 km per month. No additional payment for this service will be paid and the Contractor shall consider it within the Contract price. The inspection vehicle will be provided at the start of contract i.e within one month of issue of LOA and continue till the last date of AMC

For all other purposes, this vehicle will be treated as “Contractors Equipment”..

11.3 Provision of Office Equipment to Engineer & Employer

The Contractor will provide the following Office Equipment for the exclusive use of the Engineer & Employer's staff:

a. Up-to-date model laptop/ Desk top Computer with 19inch LCD colour monitor, Keyboard, latest version of Windows/Others, Office 360 etc.- 3 sets

b. Laser Jet Printer , network ready upto A3 size – 2 Sets

c. Multi function photo copier - Scanner – Printer A4/A3 capable of reduction, sheet feed and document sorting – 1 set

The AMC/maintenance will be in the scope of contractor till the end of contract.

12 OPERATION AND MAINTENANCE MANUALS

12.1 General Requirements

12.1.1 All operating manuals, maintenance manuals and other operating, maintenance and training documentation required to be submitted to the Employer in accordance with the Contract shall be provided in seven complete sets in colour written in the English language and accompanied by a soft copy in original format.

12.1.2 The Contractor shall provide operating and maintenance manuals in sufficient detail to enable the Employer to operate, test, maintain and repair the Works to meet the specified maintainability, reliability and availability requirements.

12.1.3 Manuals shall include but not be limited to the following types:

a) equipment operations manuals prepared specifically for each group of users;

b) preventative maintenance manual including work instruction cards;

c) corrective maintenance manual including fault finding instructions;

d) equipment workshop maintenance manual;

e) equipment illustrated parts catalogue; and

f) software system manuals.

12.1.4 All manuals shall be written in a concise manner but shall be sufficient in content to provide the Employer with adequate guidance on all features of the design which impact the operation, maintenance, and repair of the Works.

12.1.5 The Contractor shall provide all new or modified manuals in three hard copies and one soft copy in original MS Office format.

12.1.6 Where customised manuals have been provided specifically for this Contract, the document shall be accompanied by all necessary source files and developmental tools for the data to enable future update and modification by the Employer.

12.1.7 The Contractor shall provide manuals in electronic format. This is in addition to the submission of manuals in hard-copies.

12.1.8 The format of the electronic copies shall be proven in at least two other applications and shall allow for links between parts catalogue and maintenance instructions.

12.1.9 The Documents Management System and Language used shall be subject to the Employer's review and Approval.

12.1.10 The Contractor shall provide a computerised system and electronic parts catalogue to facilitate maintenance, to provide easy access to and retrieval of all forms of maintenance information from maintenance staff's computer or terminal remotely, including wired or wireless connection with the Employer's computer.

12.1.11 The Contractor shall demonstrate that the computer files supplied can be easily edited and downloaded to the Employer's computer systems with minimal effort.

12.1.12 The format used for text, illustrations and drawings shall be submitted for the Employer' Approval.

12.1.13 Each manual shall be divided into indexed sections explaining the subject matter in logical steps. Most manuals shall consist of A4 size printed sheets Where alternative sizes are proposed, (e.g. A5/A6 pocket books of schematic wiring diagrams) these shall be for review and acceptance by the Employer.

12.1.14 Information shall be provided in pictorial form wherever possible and shall include step-by-step instructions and views of the particular equipment including exploded views. Programmable equipment shall be supplied with sufficient flow charts and fully documented programmes to enable faults to be quickly identified and system modification to be undertaken at any time.

12.1.15 The Contractor shall provide clarifications and amendments to the Operation and Maintenance manuals as necessary during the execution of the Contract. Updates shall be provided for the originals and all copies.

12.1.16 The operation and maintenance manuals shall comply as a minimum with the following specific requirements.

a) The page size shall be A4 international for text.

b) Foldout diagrams or illustrations may be employed with a maximum size of A3. The title shall be visible in the lower right corner when the sheet is folded.

c) Covers shall provide protection appropriate for their use and to a standard to be agreed with the Employer clearly and uniformly marked with the subject matter and reference number.

d) The paper and ink shall resist smearing, fading, and deterioration from age and shall be suitable for use in a maintenance shop environment.

e) All paper shall be bound in loose-leaf type binders with a binding arrangement that shall permit the manual to be laid flat when open at each page.

f) The document shall be collated and numbered in proper order and correspond to the contents and index tables.

g) Nomenclature or references to any items of equipment, diagrams, figure numbers or units shall be consistent throughout the text.

h) Wherever useful to aid comprehension of the text, diagrams, drawings, sketches and actual photographs shall be added.

i) Precautions and warnings regarding the safety of personnel and equipment shall be included where applicable.

12.1.17 The Contractor shall submit three (3) complete sets of Preliminary Operations and Maintenance Manuals as per the Key Dates in 'Conditions of Contract'.

12.1.18 The Contractor shall submit three (3) complete sets of Pre-final Operations & Maintenance Manuals as per the Key Dates incorporating feedback from training up to that date and suitable for use during the Trial Running, including one set in an approved electronic format.

12.1.19 The Contractor shall submit six (6) complete sets of Final Operations and Maintenance manuals updated as required with feedback from the Trial Running including one set in an approved electronic format to be issued for use in Revenue Service.

12.1.20 For any modifications or situations which warrant a change in maintenance practice, the Contractor shall be responsible for updating all relevant approved manuals and corresponding copies in electronic format until the Warranty Period expires. Revisions in manuals/electronic format shall be properly recorded by the Contractor to ensure that they are traceable by the Employer.

12.2 Functional Requirement

12.2.1 Not used

12.2.2 The Equipment Operations Manual shall explain but not limited to the purpose and operation of the complete system together with its component subsidiary systems and individual items of equipment and shall include without limitation the following information.

a) A general description of the equipment, other relevant or connective equipment and its subsystems.

b) Operating and warning/safe instructions.

c) The theory of operation of all modules/assemblies/printed circuit boards complete with block diagrams/exploded diagrams.

d) Illustrations depicting equipment locations and layouts together with appropriate nomenclature to facilitate maintenance.

e) Common fault handling procedures and major incident, e.g. recovery procedures.

12.2.3 The Contractor shall provide maintenance manuals showing details of all the various systems and sub-systems from a maintenance and fault finding standpoint, with particulars of operating parameters, tools for dismantling and testing, methods of assembly and disassembly, tolerances, repair techniques and all other information necessary to set up a repair and servicing programme.

12.2.4 The Preventive Maintenance Manual shall include without limitation the following information.

a) General standard practices applicable to maintenance and repair of the equipment.

b) A lubrication list.

c) Schematic diagrams.

d) A cleaning agent list.

e) Wiring and cabling diagrams, including interconnection lists with source and destination descriptions for each wire with its unique label.

f) A torque schedule for various types of fasteners.

g) A paint list.

h) A material specification list for various structures and parts.

i) Technical data list for all replaceable items.

j) An applicable special tools and test equipment list.

k) A master schedule for the periodical maintenance in matrix form listing all maintenance schedules for different periodic maintenance and cleaning of all modules / sub-assemblies.

l) A checklist for each level of examinations/overhaul from the lowest level of examination to mid-life overhaul. The list shall include items of equipment, which determine the maximum interval of a particular examination/overhaul, and are Safety Critical.

m) A bill of materials for each level of examination.

n) Detailed work instructions for the inspection, reconditioning, testing, adjustment of all assemblies/modules/subsystems for each level of examination/overhaul which shall include all precautions to ensure safety to personnel.

o) A trouble shooting flowcharts for common failure symptoms.

12.2.5 The Equipment Workshop Maintenance Manual shall include without limitation the following information.

a) A master schedule for the overhaul and mid-life refurbishment of the equipment, including all modules/assemblies/components.

b) A bill of materials for workshop overhaul and mid-life refurbishment programmes.

c) Workshop overhaul procedures for dismantling, lifting, inspection, re-assembly and testing of the equipment including all assemblies/modules which shall incorporate work instructions and associated precautions to ensure safety to personnel.

12.2.6 The Equipment Illustrated Parts Catalogue covering all equipment supplied shall contain sufficient information to identify and requisition the appropriate part by maintenance staff and shall include without limitation the following information.

a) Equipment hierarchy for the equipment, modules and assemblies, down to component level.

b) An alphanumeric list of components and related parts, including description, component identification code (similar code as used in the equipment hierarchy), name of the supplier, supplier's part number and Contractor's part number (if different), drawing number and the following additional details:

(i) Quantity and Unit

(ii) Part number of next higher assembly (usually a line replaceable unit).

(iii) Category: e.g. consumable, line replaceable unit, repairable.

(iv) Life expectation (Mean time between failure or mean distance between failure where available)

(v) Shelf life.

c) A series of illustrations to indicate the location of each replaceable item, which shall be clear and progressive with exploded views to enable parts to be identified easily by cross-reference with the alpha-numeric list.

d) An indicative price list which shall list in alpha-numeric sequence the part number with the price, lead time and supplier.

12.2.7 The Software System Manuals shall include without limitation for each software package and each piece of equipment that incorporates programmable devices, including all software that has been prepared specifically for this application, the following information.

a) The operational environment requirements.

b) The operation procedures.

c) The debugging procedures.

d) The testing and/or simulation procedures.

e) The verification and/or validation procedures prior to returning to normal operation.

12.2.8 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:

(i) manufacturers' documentation supplied as standard with the equipment;

(ii) hardware configuration with details of expansion capabilities and options;

(iii) programme loading instructions, including runtime environment configuration;

(iv) programme listing including comprehensive 'comment statements' in hard copy and soft format for source code, compilers and development tools necessary to modify and recompile software;

(v) flow charts, data flow diagrams and state diagrams as appropriate;

(vi) description of software modules including purpose, linkage with other modules, error routines and any special considerations;

(vii) memory maps for both internal and peripheral memory showing description of all programmes, data files, overlay areas, memory available for expansion and the like;

(viii) loading and operating instructions for diagnostic programmes and specifically developed debugging tools; and

(ix) programming manuals relevant to operating systems, languages, development tools, etc.

12.2.9 The documentation of software may be supplied after the expiry of the warranty period, under terms and conditions acceptable to the Employer. The manual shall also include inspection/overhaul procedure and periodicity of various inspection/overhaul schedules in detail including the tools, special tools/plants, and facilities required. The manual shall be subject to review and acceptance by the Employer.

12.3 As Built drawings and Documentation

12.3.1 The Contractor shall prepare and submit to the Engineer as-built drawings and documents of the Works, showing all Works as executed. The drawings shall be prepared as the Works proceed, and shall be submitted to the Engineer for his inspection. The Contractor shall obtain the consent of the Engineer as to their size, the referencing system, and other pertinent details. Contractor shall submit as-built drawings and Documents in six hard copies and one electronic copy at least one month prior to the Tests on Completion for review by the Engineer. The drawings shall represent a true scale picture of the works

12.3.2 All The drawings shall represent to scale picture of the Works. The As-Built Drawings and Documents shall include but not limited to:

i) Arrangement drawings for all sub-system and individual items of equipment;

ii) Installation and fixing drawings for all sub-system and individual items of equipment;

iii) interface sub-system and individual items of equipment;

iv) Schematic drawings for all electrical, electronic, communication, pneumatic, hydraulic, water and drainage systems etc;

v) Sizes, material and finish of all fixtures

vi) Manufacture's code, drawings and reference numbers;

vii) Wiring diagrams including internal wiring of sealed unit items;

viii) Setting dimensions and tolerances; and

ix) Asset register of all the assets procured under the contract indicating the manufactures name, Sr. no., quantity, year of manufacture/installation/commissioning etc.

13 PACKING AND LABELLING

13.1 Storage, Packing and Protection of Equipment

13.1.1 The Contractor shall be fully responsible for the provision and maintenance of acceptable storage facilities for the Plant and any materials or equipment he intends to use for the carrying out of the Works.

13.1.2 All equipment shall be delivered to the Site in new condition, properly packed and protected against damage due to handling, adverse weather or other circumstances and, as far as practicable, shall be kept in packing cases and/or under protective coverings until required for use.

13.1.3 Not used

13.1.4 All packaging procedures shall be submitted to the Employer for approval.

13.1.5 All empty cases, materials, crates, or packages shall be removed from the Site by the Contractor within 1 month of their being emptied.

13.1.6 Spare parts shall be suitably packed for storage for a period not less than the specified shelf life without deterioration and shall be clearly identified, showing the following information without any need to unwrap packaging:

i) Ownership (Kolkata Metro East West Line)

ii) Shelf life.

iii) Type of storage.

iv) Description of item and relevant part number.

v) Serial number, if applicable.

vi) Inspection Certificate number and batch number - that is, the number allocated by the Contractor's Inspector at the time of manufacture or packing.

13.1.7 Electrical and other delicate items or equipment shall be cocooned.

13.1.8 Cable ends, cable entry points into equipment and other similar terminations and openings shall be sealed or blanked off to prevent the ingress of dirt or moisture.

13.1.9 Tube ends and other similar openings shall be thoroughly cleaned and then blanked off to prevent ingress of vermin, insects, dirt or moisture and to provide protection against damage.

13.1.10 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 of suitable materials firmly fixed in position.

13.1.11 Particular care shall be taken to prevent damage to, 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 compositions shall be used, of sufficient strength to resist chafing under the pressures and movements likely to occur in transit.

13.1.12 Care shall be taken to minimise risk of damage to ball and roller bearings in transit. Spare ball and roller bearings and similarly protected items shall not be removed from the manufacturer's wrappings or packing.

13.1.13 Each case, crate or package shall be of robust construction and suitable for the intended purpose. Packaging materials that are likely to suffer deterioration in quality as a result of exposure to environmental conditions likely to be met during transit from the factory of origin to the Site shall not be used.

13.1.14 The contents of each case, crate or package shall be protected against the harmful effects of ingress of water by enclosing them within a heavy duty waterproof membrane, and adding a suitable desiccant substance (e.g. silica gel) to the case, crate or package.

13.1.15 Each case, crate or package shall be clearly and indelibly marked with the address, Contract number, the Employer's name, '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 Site.

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

13.1.17 A second copy of the packing list shall be enclosed in a watertight enclosure on the outside of each case, crate or package. Distribution of additional copies of each packing list shall be in accordance with the requirements of the Employer.

13.1.18 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.

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

13.1.20 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.

13.1.21 Details of cases, crates, packages, containers, etc., intended to hold important or valuable or delicate items of equipment or materials shall be submitted to the Employer for approval.

13.1.22 The Contractor shall prepare, protect and store, in a manner acceptable to the Employer, all equipment and materials so as to safeguard them against loss or damage from repeated handling, climatic influences and all other hazards arising during shipment or storage on or off the Site.

13.1.23 Secure and covered storage shall be provided by the Contractor for all equipment and materials except as otherwise agreed by the Employer as being suitable for open storage.

13.1.24 The Contractor shall accomplish necessary and periodical maintenance activities to ensure all equipment in storage will remain fit for use at least up to the end of the specified shelf life.

13.1.25 The Contractor shall suitably protect, encase or cover up, as may be appropriate, all new plant and equipment and instruments installed by him, against damage due to building operations, adverse weather or other causes up to the commencement of revenue service.

13.2 Equipment Identification and Labelling

13.2.1 The Contractor shall indelibly label all equipment and materials of the Works to show, as a minimum, its identity, type, version, function, location, rating and limitations.

13.2.2 Removable modules shall have the same indelible labelling on the fixture to which the module is attached. The label shall be adjacent to the module and shall not be obscured.

13.2.3 Where any hazardous situation could arise due to voltage level, air pressure, maladjustment, mis-operation, etc., then prominent warning labels shall be provided to denote this.

13.2.4 In general, all labels shall be in Hindi, Bengali and English language. Where appropriate, such labels shall conform to accepted national or international standards.

13.2.5 Equipment identification and rating labels may be in English only where the equipment is only accessible to authorised maintenance staff.

13.2.6 All labelling shall correspond to the Schedules and diagrams to be provided as part of the As Built Drawings.

13.3 Shipping

13.3.1 The Contractor shall notify the Engineer ten 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.

13.3.2 Two copies of packing lists and quality certificates shall be attached to each case or package to be shipped. 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.

13.3.3 The Employer shall clear the Works to be supplied under the Contract through Kolkata customs/Indian sea port in accordance with all Government of India Enactments. The Contractor shall provide all support for the such clearance.

13.4 Delivery

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

13.4.2 The Contractor shall unload the Works and all items to be supplied under the Contract at the designated delivery point and positioning or storing them.

13.4.3 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.

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

13.4.5 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.

13.4.6 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

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

14 PUBLIC RELATIONS

14.1 Public Relations

14.1.1 The Contractor shall, liaise with the Public Relations Officer of the Employer on all press and public relations matters in connection with the Contract.

14.1.2 All press releases, press statements, articles or printed material prepared by the Contractor shall be submitted to the Employer, prior to publication or release to the news media.

14.1.3 All press queries relating to the Contract received by the Contractor must be referred to the Employer for clearance. The Contractor is not allowed to be interviewed by the press or divulge any information freely to reporters without first seeking clearance from the Employer.

14.1.4 Use of the Kolkata Metro East West Line logo in the Contractor's publications shall be subject to approval of the Employer.

14.1.5 The Contractor shall provide the Employer with schedules relating to night works, traffic diversions, closure of road etc. that may cause inconvenience to the public.

14.1.6 The Contractor shall extend to the Employer all the necessary assistance and co-operation with regard to requests for photo-taking, video-taking and visits to the Site by the Employer's official photographer or appointed film-maker.

14.1.7 The Contractor shall include a section on matters concerning Public Relations in his monthly report to the Employer.

14.1.8 All hoardings and signboards put up by the Contractor shall be maintained in good condition.

14.1.9 All public complaints should be thoroughly investigated and acted upon by the Contractor on an urgent basis.

14.1.10 The Contractor shall give full support to all functions and events e.g. community talks for residents, Site visits for the media etc. organised by the Employer during the period of the Contract.

14.2 Photographs

14.2.1 In addition to the requirement to submit photographs at regular intervals as detailed below, the Contractor shall prepare and submit at regular monthly intervals, or such other intervaks as may be required by the Engineer, a complete written documentation of the Execution of the Works in such sufficient detail as may be specified by the Engineer . Such documentation shall include the key activities undertaken, key challenges faced, if any, any specific features to be brought to the notice of the Engineer. Such documentation shall primarily be used by the Employer for the purpose of preparing a chronicle of the Project's construction and implementation works.

14.2.2 The number of photographs taken and the subjects photographed shall be as directed by the Employer. Sufficient photographs shall be taken and supplied to the Employer to enable selection of the photographs that in its opinion provide the best record.

14.2.3 Photographs shall be taken using a high resolution digital camera and picture files shall be provided in raw data format for softcopy. The resolution of photographs shall be sufficient for clarity when photographs are enlarged to A4 size.

14.2.4 All photographs shall be date and time stamped by the camera.

14.2.5 Each photograph shall have a forty millimetres by eighty millimetres title block in the lower right-hand corner which shall show the following information:

KOLKATA METRO EAST WEST LINE CONTRACT No.:

CONTRACT NAME:

CONTRACTOR:

PHOTOGRAPH No.:

DATE

DESCRIPTION:

14.2.6 Each monthly set of photographs shall be accompanied by an A4 size schedule indicating the subject, date, locations and directions in which the photographs were taken.

14.2.7 The photographs shall become the property of the Employer.

14.2.8 Not used.

15 GENERAL PERFORMANCE REQUIREMENTS

15.1 General Requirements

15.1.1 The Works shall conform to the relevant Technical Specification(s) and other overall system requirements as stated below.

15.1.2 The Kolkata Metro East West Line will be operated on a commercial basis and shall offer a high quality of service.

15.1.3 The Contractor shall execute the Works such that they will contribute in ensuring a safe, efficient, reliable, attractive, clean, comfortable, quiet and user friendly service for the travelling public, and will assure the safety and security of the personnel who work on or about the Kolkata Metro East West Line.

15.1.4 The Kolkata Metro East West Line shall be accessible to physically challenged people and shall be environmental friendly installation.

15.1.5 The Contractor shall design the Works in a manner consistent with the achievement of the objectives set down in this Clause.

15.1.6 The Contractor shall provide input to the System Operating Plan as required by the Employer.

15.2 System Operating Plan

15.2.1 The Contractor shall take due account of the System Operating Plan as prepared and periodically updated by the Employer. The key elements of this System Operating Plan affecting the Works are as follows.

15.2.2 The Kolkata Metro East West Line will be operated as a round trip service between Howrah Maidan and Salt Lake Sector V with trains stopping at all intermediate stations.

15.2.3 The service will be provided by a fleet of Trains each comprising six Vehicles travelling at speeds up to 80 km/h under normal operating conditions.

15.2.4 The maximum operational speed and any lower operational speed limits required by the alignment shall be imposed by the ATP system and shall be fixed by safety and passenger comfort considerations only.

15.2.5 The dwell time at each station shall not be less than 20 sec except Howrah, Esplanade and Sealdah where it will be 45 secs.

15.2.6 Vehicles shall be designed for one person operation with provision for both ATO and manual driving with the assistance of cab signalling indications and ATP.

15.2.7 Under ATO, driving control shall be predetermined to give a range of performance levels including energy saving driving profiles.

15.2.8 Whilst operating in this mode, the driver's normal function shall be limited to controlling or monitoring door opening and closing, initiating safe departure from station platforms, ensuring the safety of the Train by visual observation of the line ahead, monitoring and reacting to fault alarms and indications, responding to voice radio communications from the OCC and giving

information to and responding to emergency calls from passengers through the trainborne communication systems.

15.2.9 Manual braking control shall override ATO control in all circumstances.

15.2.10 A passenger carrying service will be provided 365 days per year (366 in a leap year).

15.2.11 In the event of technical failure or operational difficulties, the Works shall be designed such that alternative service patterns can be operated in order to optimize, to the maximum practical extent, the passenger carrying capacity of the available track layout and facilities of the Kolkata Metro East West Line.

15.2.12 The Contractor shall provide facilities to enable bi-directional operation and the running of short loops and shuttle services to minimise the effects of incidents leading to line closures.

15.2.13 Operation of Trains within the Depot areas shall be manual, with line of sight driving.

15.2.14 The maximum speed of the Trains within the Depot areas shall be limited to a speed to be defined by the Employer not exceeding 25 km/h by the on-board ATP system.

15.2.15 Integrated, comprehensive communications systems shall be provided to ensure the efficient, cost effective and flexible operation of the Kolkata Metro East West Line.

15.2.16 The communications systems, including each individual item of associated equipment, shall be designed to take account of the configuration of the Kolkata Metro East West Line and be fully co-ordinated with all other disciplines and operational strategies and procedures necessary for efficient operation of the Kolkata Metro East West Line and be configured for high availability and reliability.

15.3 System Performance

15.3.1 The Contractor shall meet the RAMS requirements specified in General System Assurance Requirements.

15.4 Alignment

15.4.1 The general alignment along the Main Lines and the access track leading up to the Depot is predominantly fixed by work already carried out by the Employer.

15.4.2 A preliminary track layout and alignment within the Depot has already been determined by the Employer to fit within the constraints of the available land.

15.4.3 The Contractor shall develop the Works as applicable to the Depot based on this layout but shall develop the design as required to meet the requirements of this Contract and shall coordinate closely with the Employer throughout this process.

16 QUALITY ASSURANCE

16.1 General Requirements

16.1.1 Quality assurance document shall be submitted by the Contractor.

17 SYSTEM ASSURANCE

17.1 General Requirements

17.1.1 System assurance document shall be submitted by the Contractor

Annexure - 1

Materials and Workmanship

Materials and Workmanship

CONTENTS

1 MATERIALS

1.1 General

1.1.1 All materials and construction shall meet the requirements of NFPA 130, or other approved standard. Laboratory test results for each test shall be submitted.

1.1.2 Materials used for construction shall be in accordance with the stated specification unless written approval for substitution is obtained.

1.1.3 All equipment shall be constructed in a sufficiently robust manner and arranged so as not to suffer deterioration, wear, or damage due to vibration or shock loads encountered in traction service.

1.1.4 Fixings shall be locked adequately to prevent loosening in service.

1.1.5 Equipment shall be arranged into groups where practicable the items of any one group being mounted on a common frame or the equivalent, complete with wiring, piping and other fittings. All such equipment shall be protected against damage caused by dirt, dust, moisture and corrosion.

1.1.6 The following materials shall not be used in the construction:

(i) Asbestos

(ii) Lead

(iii) Urethane foam

(iv) Urea formaldehyde

(v) Polystyrene

(vi) Viton rubber

1.1.7 Aluminium threaded fasteners shall not be used except for tapped holes in solid aluminium structures.

1.1.8 Foreign matter such as shavings, chips and other debris shall be completely removed from all parts of the vehicles whether hidden or exposed.

1.1.9 Surfaces exposed to passengers, crew, or maintenance personnel shall be smooth and free from burrs, fins, sharp edges and dangerous protrusions.

1.2 Metals

1.2.1 Low-Allow High Tensile Steel

1.2.1.1 Low-alloy high-tensile steel (LAHT) wherever used shall conform to the requirements of ASTM A 588 or other standards approved by the Employer for structural shapes, plates and bars.

1.2.1.2 Cold-rolled and hot-rolled LAHT sheet and strip wherever used shall conform to the requirements of ASTM A 606, Type 4 or other standards approved by the Employer.

1.2.2 Stainless Steel

1.2.2.1 Stainless steel components wherever used shall be of AISI type 301 LN or other approved standard and shall conform to the requirements of ASTM A 666 or other appropriate standard approved by the Employer.

The finishes shall be of Stainless Steel Grade 304 Grade 4 satin finish

1.2.2.2 Chromium content shall not be less that 17% and carbon content not greater than 0.12% for structural members unless otherwise agreed with the Employer.

1.2.3 Steel Castings

1.2.3.1 Steel castings used in any location in the vehicle shall be selected for the composition, heat treatment and design best suited for the intended service. The Contractor shall show evidence of testing and inspection, and acceptance of castings in accordance with procedures described in AAR specification M-201, or other appropriate specification approved by the Employer.

1.2.4 Aluminium

NOT USED

1.3 Non-Metals

1.3.1 Safety Glass

1.3.1.1 Glazing shall be safety glass which shall not be degraded by ultraviolet or visible light or temperatures that can be obtained by solar heating. All edges shall be ground smooth.

1.3.1.2 Safety Glass shall comply with the applicable requirements of ANSI Z26.1, or other appropriate standard approved by the Employer.

1.3.2 Plywood

NOT USED

1.3.3 Glass Reinforced Plastics

1.3.3.1 Glass fibre Reinforced Plastics (GRP) may be used on non-structural parts, for cover and other applications. They shall be manufactured and moulded to an approved process with particular regard to non-flammability and smoke emissivity.

1.4 Joining and Fastening

1.4.1 General

1.4.1.1 Direct contact between electrically-dissimilar metals shall be prohibited except for electrical connections between copper and aluminium where appropriate joint compounds are used. Isolating and moisture-proofing materials, appropriate to the materials being joined, shall be used at all times. All mechanical fasteners shall be to ANSI or other standards approved by the Employer.

1.4.2 Bolts and Nuts

1.4.2.1 On the interior of cabinets or boxes, all exposed screws shall be stainless steel flat or oval head.

1.4.2.2 All exposed bolts shall be stainless steel, and all exposed nuts shall be stainless steel, unless otherwise specified.

1.4.2.3 Exposed screws shall be of an approved tamper-proof type.

1.4.2.4 The design strengths for ANSI Grade 2 or equivalent bolts and Class A or equivalent nuts shall be used in sizing the mounting and attachment bolts for under floor-mounted equipment and equipment support structures or brackets. However, all structural or load-carrying bolts shall be a minimum of ANSI Grade 5 or equivalent.

1.4.2.5 Plated steel screws or bolts, nuts, flat washers and lock washers, with both the steel and plating suitable for use in high temperatures without degradation of the strength of the hardware or its resistance to corrosion, shall be used in mounting, and in making connections to, resistors and other heat-producing apparatus.

1.4.2.6 Flat washers shall be used on both sides of all electrical connections (that is, under bolt head and under nut). Bolts shall not be used to carry electrical current.

1.4.2.7 Cadmium plating shall not be used.

1.4.3 Rivets

1.4.3.1 Rivet holes shall be located and aligned accurately and, when necessary during assembly, holes shall be reamed round to the specified size in position.

1.4.3.2 Hand-driven rivets shall be driven hot and shall completely fill the holes.

1.4.3.3 Mechanically-driven rivets may be driven cold. Heads shall be concentric with the shank of the rivet.

1.4.3.4 Exposed heads shall be free from rings, fins, pits, and burrs.

1.4.3.5 Any rivet that is removed shall be replaced with a rivet of the next larger size, after the hole has been reamed to the appropriate size.

1.4.3.6 Rivets and lock pins exposed to passengers on the outside of a passenger vehicle shall be stainless steel or aluminium, as appropriate for the materials being joined.

1.5 Protection of Metals

1.5.1 All metals to be used in the fabrication process shall be surface treated with due consideration to the severity of exposure to which the surface will be subjected.

1.5.2 The joining of incompatible metals and materials shall be minimised and where unavoidable, adequate care shall be taken to prevent any chemical interaction between the materials.

1.5.3 After fabrication, all low-alloy steel areas shall be painted with one coat of an approved primer followed by one coat of an approved sealer to prevent rusting.

1.5.4 Exterior steel surfaces, including roof, underframe, underside of flooring, and equipment, shall receive a minimum of two coats of primer.

1.5.5 Exterior surfaces, except the underframe and underside of the flooring, shall then be given a surface coating and a minimum of two coats of polyurethane for a minimum of 5 year's service life.

1.6 Welding and Brazing

1.6.1 Welding

1.6.1.1 All welding procedures shall be in accordance with American Welding Specifications (AWS) or with BS4870 and BS4871 specifications or others approved being used to define the welding procedure acceptance and welder acceptance respectively.

1.6.1.2 No cracking, lack of fusion, surface inclusions or porosity shall be permitted on any load carrying joint or at points on vessels that are to contain fluids or gases.

1.6.1.3 All structural welds shall achieve full penetration of the joint and shall not show any loss in structural thickness (undercutting).

1.6.1.4 Welding of stainless steels, aluminium or its alloys and high tensile steels shall be as specified by the Contractor in consultation with the manufacturers of the metals and agreed with the Employer.

1.6.1.5 Aluminium alloys shall be welded by the metal-inert gas process.

1.6.1.6 Welds shall be butt welds and in all cases complete and adequate fusion with the base material shall be obtained without loss of structural thickness (undercutting) or the excessive inclusion of porosities, slag inclusions or other metallurgical defects.

1.6.1.7 The Employer may require the quality of individual welds, particularly in critically stressed areas, to be verified by an accepted Non-Destructive Testing (NDT) procedure.

1.6.1.8 Welding shall not be carried out on parts which surfaces have already been treated except where the treatment applied is specifically formulated so as not to impair the welding process.

1.6.1.9 Arc welds shall be by an accepted gas shielded arc method.

1.6.1.10 Laser Welding shall be used, wherever possible, in preference to spot welding.

1.6.1.11 Spot welding of components carrying structural stresses shall be performed using equipment fitted with time, current and pressure control.

1.6.1.12 Where hand welding of components carrying structural stresses is accepted the Employer reserves the right to inspect and accept the qualifications of the operatives. Hand welding of such components will only be accepted where the Employer is satisfied that alternative methods are impracticable.

1.6.1.13 If automatic seam welding is proposed for components carrying structural stresses, the Employer reserves the right to inspect or accept the process.

1.6.1.14 All welders shall have been tested to determine their ability to operate the welding equipment used in making the required welds and to produce satisfactory welds.

1.6.1.15 Before welding of any type is started, parts to be joined shall be cleaned of coatings and films such as rust, oxide, mill scale, oil, grease, corrosion products, and other foreign materials. Parts to be joined by welding shall be supported and held in position by tables, jigs, or fixtures.

1.6.1.16 The method used in depositing weld metal shall be one that reduces warping and locked-up stresses. To achieve this, tack welding, offset welding, skip welding, and other devices and sequences well known to the art shall be used where appropriate. A stress relieving process suitable for the type of material shall be employed to remove any locked-up stresses.

1.6.2 Brazing

1.6.2.1 All brazing shall be in accordance with the requirements and recommendations of the AWS Welding and Brazing Handbook, or other approved by the Employer. Quality control procedures necessary to ensure high-quality brazing shall be maintained.

1.6.2.2 The use of backing bars for achieving full penetration shall be avoided in regions of high stress.

1.7 Pipework, Tubing and Pressure Vessels

1.7.1 Pipework and Tubing

1.7.1.1 All piping, valves, fittings, installation methods, and testing shall be in accordance with the latest edition of the Code for Pressure Piping, ANSI B31.1, or other approved specification.

1.7.1.2 Joints in a straight run of pipe that serve the sole purpose of connecting pipe lengths shall not be used.

1.7.1.3 All inaccessible runs of tubing or piping shall be without joints.

1.7.1.4 After installation, all piping systems shall be cleaned by methods approved by the Employer.

1.7.1.5 Pipes shall be supported adequately throughout their length and at connections and shall not interfere with the removal of other components.

1.7.1.6 Vehicle body air lines shall be of a suitable capacity and shall be stainless.

1.7.1.7 All air pipework shall be installed in accordance with an approved standard and in such a manner as to provide drainage.

1.7.1.8 Air pipework shall be deburred and blown out after cutting and thoroughly cleaned after installation.

1.7.1.9 Air filter assemblies with replaceable filter elements shall be provided, in accordance with the friction brake supplier's recommendation. The filtering capability, flow rate capacity, and overall size shall be appropriate for the application so that the filter replacement interval shall be greater than 1 year. It shall be possible to gain access to the filter element for replacement purposes without disconnection of any pipe fittings.

1.7.2 Pressure Vessels

1.7.2.1 Unfired pressure vessels shall conform to the latest revision of Section VIII of the ASME Boiler and Pressure Vessel Code for Unfired Pressure Vessels, or other approved standard. Test reports shall be furnished for each pressure vessel and each pressure vessel shall be stamped or marked as required by the above code to document its having passed the test.

1.8 Lubricants, Bearings and Pivots

1.8.1 All bearings and pivots shall be of ample proportions to withstand shock loads and vibration in addition to the normal static and dynamic loads.

1.8.2 Metal to metal wearing surfaces shall be avoided wherever possible.

1.8.3 Plain bearings shall be of the dry type (incorporating graphite compound, PTFE or nylon, lubricant retaining bearing metal or similar).

1.8.4 Plain bearings or pivots requiring periodic applications of oil or grease at inspection are not favoured.

1.8.5 The use of bearings which require lubrication or inspection at intervals more frequently than once a year, will require special approval.

1.8.6 A list of recommended oils and greases for all equipment shall be supplied by the Contractor.

1.8.7 Rolling element bearings shall preferably be of the pre-packed pre-lubricated and sealed type and shall run, between overhauls without re-lubrication or replacement.

1.8.8 Care shall be taken to ensure that brinelling does not occur.

1.8.9 Where pre-packed bearings are not applicable, the arrangement shall be for approval and the means of lubrication replenishment shall be fitted with nipples or equivalent. The return path for excess grease shall be provided where necessary.

1.8.10 Replenishment interval shall be not less than 1 year and the recommended annual replenishment quantity of grease shall be stated.

1.9 Thermal, Acoustic Insulation and Rust Proofing

1.9.1 Thermal insulation materials of the rigid, non-rigid, or spray-on type shall be used. The materials shall not absorb liquids or gases and shall possess the required properties to meet the noise, vibration, rust prevention and heat loss limits recommended to AWS or other approved standard.

1.9.2 The insides of posts, side sills and drainage pipes, if of steel, shall be treated with accepted rust preventing material.

1.9.3 The underside of roof sheets and side sheets including stainless steel shall be sprayed with at least 3mm thickness of accepted rust proofer and sound deadener.

2 ELECTRICAL WORKS

2.1 General Requirements

2.1.1 Electric power shall be received at main low voltage intake switchboards and distributed via a series of sub-main panels, isolating switches and distribution boards to all consumer points.

2.1.2 In the design of switchboards an allowance of 20% spare space capacity shall be provided for possible future extension and all main switchboards shall be of the extendable pattern.

2.1.3 NOT USED

2.1.4 NOT USED

2.2 LV Switchboards and Switchgear

2.2.1 All assemblies of LV ac switchgear and control gear shall comply with the requirements of IEC 60439-1 (Low-voltage switchgear and control gear assemblies - Part 1: Type-tested and partially type-tested assemblies) or equivalent standards.

2.2.2 The clearance in front of all assemblies of LV ac switchgear and control gear shall not be less than 1.2 metres.

2.2.3 All removable switchgear shall be provided with mechanical lockable shutters.

2.2.4 LV ac switchboards installed at concourse or plant rooms shall be metal clad comprising the assembly of LV ac switchgear, control gear and components and shall be floor standing of the multi-cubical type being 2.2m high maximum in accordance with IEC 60529. For LV ac switchboards installed at concourse or plant rooms, the degree of protection shall be IP54. For outdoor application, an IP65 enclosure shall be provided for extra protection of the LV ac switchboard

2.2.5 LV ac switchboards shall be suitable for indoor service on nominal 80/220, 208/120, or 190/110 V ac, 3-phase, 3 wires or 4 wires, 50 Hz supply, in a TN-S type LV power system.

2.2.6 The busbars and equipment shall be rated to withstand the fault level of the LV ac system.

2.2.7 The switchboard shall be capable of accommodating a rated short time withstand current of following kA rating for 1 second and a fault withstand classification of 'Class 3' based on the nominal supply voltage between phases at 50 Hz.

2.2.8 For busbar maximum current rating below 1250A, 35KA with Earth bar sized at 200mm^2.

2.2.9 For busbar maximum current rating 1250A to 2500A, 50KA with copper earth bar sized at 300mm2 or above.

2.2.10 For busbar maximum current rating above 2500A to 3800A, 65KA with copper earth bar sized at 400mm2 or above & above 3800A, 85KA with copper earth bar sized at 500mm2 or above.

2.2.11 The contractor shall provide the higher KA rating if the 1 second short current of one switchboard is higher than above rating based on the fault current calculation.

2.2.12 Protection against electrical shock in normal service shall be achieved by the provision of barriers or enclosures both vertical and horizontal and between adjacent units to ensure segregation and prevent accidental contact with live parts, or by complete insulation of all live parts.

2.2.13 Cable terminations shall be suitable for the size and type of cables used.

2.2.14 Where armoured multi-core and mineral insulated copper sheathed (MICS) cables terminate inside the switchboard enclosure, glanding plates or glanding brackets shall be provided for securing the cables to the switchboard.

2.2.15 Glanding plates, glanding brackets and extension boxes shall be removable and shall be of adequate size for the particular cables to be terminated.

2.2.16 Separate current transformers shall be provided for each protection device and for instrumentation.

2.2.17 Adequate spare protective devices shall be provided on every busbar segment of the LV main switchboard for future load growth as specified in the following Table 2:

2.2.18 Table 2: Spare Protective Devices

Busbar Breaker Rating (A)	Spare Protective Device (three phase & neutral)
600 – 1000	1 x 100 A, 1 x 200 A
1000 – 1600	1 x 100 A, 2 x 200 A
Above 1600	1 x 100 A, 2 x 200 A, 1 x 400 A

2.2.19 NOT USED

2.2.20 Circuit breakers shall comply with the requirements of IEC 60947-2 and shall be capable of accommodating the design uninterrupted current rating, when enclosed and in their operating environment, with a rated operational voltage as specified for the switchboard.

2.2.21 The circuit breaker shall meet the fault conditions specified for the switchboard.

2.2.22 Circuit breakers shall be of the metal clad withdrawable type and electrically isolated

when removed to provide for safe maintenance.

2.2.23 Low voltage air break switches shall comply with the requirements of IEC 60947-3 (2001) or equivalent standards with an uninterrupted rated duty, and with minimum utilisation category ac 23 or higher according to typical applications defined in IEC utilization categories.

2.2.24 Each switch shall be provided with facilities for padlocking in the "OFF" position.

2.2.25 To prevent accidental contact with live parts, switches of the withdrawable chassis type or insulating type, shall include either fully shrouded fixed contacts or insulated cover plates.

2.2.26 MCB's (Miniature Circuit Breaker) shall be provided in accordance with the requirements of IEC 60898.

2.2.27 The current rating and type of MCB's shall be appropriate to the application with the nominal voltage.

2.2.28 The frame current rating of MCB shall be not over 125A, and the standard short circuit interruption capacity for the MCB's shall be 10 kA.

2.2.29 Any circuit breakers with the frame current rating higher than 125A or the short circuit interruption capacity higher than 10 KA shall be moulded case circuit breaker (MCCB) or air circuit breakers (ACB) complied with the requirements of IEC 60947-2.

2.2.30 Circuit breakers shall be lockable by means of a padlock in both the 'drawn in' and 'drawn out' positions.

2.2.31 Circuit breakers shall be removable from the rack or chassis when in the 'drawn out' position, or shall be removable when in the 'drawn in' position when in the open state.

2.2.32 For circuit breakers whose frame current rating are at 800 A or above, ACBs (Air Circuit Breaker) shall be used.

2.2.33 Contactors shall comply with the requirements of IEC 60947-4 and shall be of the break type having an uninterrupted rated duty, and shall have the appropriate utilisation category according to different applications of load defined in IEC utilization categories.

2.2.34 Contactor operating coils shall be suitable for the phase to neutral voltage of the supply or the control power supply specified elsewhere, and shall be protected by means of a low current cartridge fuse.

2.2.35 For the appliance of lighting control, contactor shall be mechanically held or latched type if not specified elsewhere.

2.2.36 Distribution boards shall be surface mounted consisting of a case enclosing banks of moulded or ceramic fuse carriers and bases.

2.2.37 The casing shall be constructed of sheet steel of not less than 1.5 mm thickness with a hinged door hung by means of internally fixed hinges of substantial construction designed to avoid the door sagging when opened.

2.2.38 When closed, the casing shall be dust proof and entirely free from external protrusions.

2.2.39 Inside each casing the Contractor shall include a clearly visible attached label, showing details in the form of a table stating the circuit served under each number and the fuse rating.

2.2.40 The information within the table shall be printed on a durable material to ensure that all

details are permanently legible.

2.2.41 An engraved 'Traffolyte' label, with black lettering on a white background, shall be fitted on the outside of each board, indicating the number of the board, the voltage, phase and service, the exact wording to be approved by the Employer.

2.2.42 Cartridge fuses for voltage up to and including 1,000V ac shall comply with the requirements of IEC 60269 if applicable.

2.2.43 Ac power shall be distributed to motors at a nominal 3 phase 415V and 1 phase 240V, 50 Hz.

2.2.44 NOT USED

2.2.45 Dry type control power transformers (CPT) shall be used when voltages other than distribution voltage are required.

2.2.46 The Contractor shall provide grouped motor starters with display panels.

2.2.47 Motor starters shall include circuit breaker protection or fused switch protection, and shall in all events be suitable for the available overload and short circuit.

2.2.48 Motor starters shall include individual unit control transformers.

2.2.49 Small motor starters for units not requiring automatic control may be manual motor starters with overload protection.

2.2.50 Motor starters shall be provided with lockable isolators, and emergency stop pushbuttons (EPB) shall be provided beside all three phase motors.

2.3 Power Supplies

2.3.1 Power supplies shall be determined by design in conjunction with equipment manufacturers who will state their requirements in quantified terms for power, voltage, secure (dual power) supply status, position, clean earthing etc.

2.3.2 Supplies shall be provided to the required positions in the form of fused spur units, switched socket outlets, industrial plugs and sockets or isolating fuse-switches as appropriate inclusive of all cabling, backup protection, wireways and cable supports.

2.3.3 Where appropriate, residual current protection devices (RCD), extra low voltage or intrinsically safe area provisions shall be incorporated.

2.3.4 Electrical supplies shall be arranged such that loss of one or more phases of the primary supply shall automatically change supply to the secondary source of power, generally via interlocked automatic transfer switches (ATS) to prevent accidental paralleling of infeed supplies.

2.3.5 On restoration of the primary power supply this shall automatically be reselected after a predetermined time delay to avoid hunting and with short time parallel between the two sources.

2.3.6 Correct phase sequence (rotation) shall be determined for both transformer supplies before connection is made to the switchboard and after any supply reconnection that may occur.

2.3.7 Supplies shall terminate either at enclosed isolator switches or at control panels/switchboards to serve as the duty points as appropriate for the nature and location of the equipment loads.

2.3.8 All power cables including lighting and small power wiring, all fastenings for tray or rack mounted cables and all control and communications cables shall be manufactured from low either low smoke zero halogen (LSOH) materials or no-toxic fire resistant material according to different load categorizations.

2.4 Low Voltage Power

2.4.1 All residual current devices (RCD) including below different categories shall be of the instantaneous type with the rating of trip current not more than 30mA and trip time not more than 0.1 second.

2.4.2 Residual current devices shall be selected and utilized according to the load type, the system grounding type, and electromagnetic interference environment from the following types:

2.4.3 RCCB (Residual Current Circuit Breaker). This is basically a mechanical switch with an RCD function added to it. Its sole function is to provide protection against earth fault currents.

2.4.4 NOT USED

2.4.5 RCD shall have compliance to IEC 61009 for RCBOs, and also to IEC 61543 (EMC requirements for RCD).

2.4.6 In offices areas, public areas, and other appropriate areas, electrical installations shall be concealed in the structure, located in voids formed by suspended ceilings, false floors, purpose built ducts, or installed in other appropriate and artistic protection facilities.

2.4.7 Unarmoured cables and wiring shall be protected by means of enclosures or conduit and trunking wireways to prevent physical damage.

2.4.8 Outlets for small power and the principle of power distribution to them shall comply with the local wiring regulations and NFPA 70 (NEC).

2.4.9 Power outlets and light switches shall be constructed of durable materials with aesthetic finishes and sealing ratings appropriate to their location and exposure to dust, moisture and other contaminants.

2.4.10 At every services load centre, the load shall be classified into the following categories.

2.4.11 Non-essential load, which shall not be supported by generators, including non-essential chillers and associated water side and air side equipment, advertising panels, concession areas, 50% of public area lighting, small power outlets in public areas, water heaters, non-essential elevators and escalators, etc.

2.4.12 Essential load, which shall be supported by backup generators, including staff area lighting, 50% of public area lighting, outlets for small power in staff areas, one elevator per platform to main entrance, fire services and mechanical loads other than those classified as non-essential load.

2.4.13 Critical load, which shall be supported by backup generators and batteries in the form of uninterruptible power supply, or maintenance-free self-contained battery system, including power supply to communications, signalling, elevator and escalator controls, Automatic Fare Collection (AFC) System, Station Management System (SMS), fire alarm and detection system, ventilation fans in hazardous areas, and emergency lighting.

2.5 Lighting

2.5.1 Lighting design shall be compliant to an approved international standard and shall take into account efficiency, application, glare, computer screen environments, maintainability and long life requirement.

2.5.2 Low brightness lighting fittings shall be installed where visual display screens are used to prevent screen glare.

2.5.3 Where large numbers of lighting fittings installed, lighting fittings shall be switched in multiple circuits in order to allow management control of lighting levels (nominally 10%, 33%, 66%, and 100% of output), and lighting fittings shall be supplied from separate power sources in order to avoid the loss of whole illumination while one power source is gone. At PSG / PSD the illumination level shall be minimum of 200 lux.

2.5.4 Internal lighting in staff areas shall be controlled by individual and/or banks of localised switches, and switching layouts and control philosophies shall complement the approved operations plans.

2.5.5 Lighting control for public areas and external lighting shall be automatically controlled by the BMS (Building Management System) with photocells sensing and manual operator override control.

2.5.6 The ON/OFF status of all lighting shall be monitored by the BMS, and the interface shall be in the form of voltage free dry contacts.

2.5.7 The type and quality of fittings and their luminous intensity shall relate to the space being illuminated.

2.5.8 The Contractor shall allow in the design for maintenance, factors of surface reflectance for the respective lighting fittings and the designated area of use.

2.5.9 Light level shall be uniformly distributed throughout the relevant area and shall be designed such that glare, dark recesses and areas of poor lighting levels are avoided.

2.5.10 At external building entrances where personnel enter from sunlit outdoor areas graduation of the lighting level shall be provided.

2.5.11 This shall also apply to the entry points to the covered stabling area where the ability of train drivers to see ahead comfortably at all times is essential.

2.5.12 Care shall be taken in the distribution of light fittings in relation to any closed circuit television cameras.

2.6 Emergency Lighting

2.6.1 Emergency Lighting design shall be compliant to the following standards, and shall have 10 lux illumination level if not specified elsewhere.

2.6.2 Setting Up Standards for Fire Protection Facilities;

2.6.3 Construction Technical Regulation;

2.6.4 NFPA 130 and NFPA 101; and

2.6.5 EN 50172.

2.6.6 Emergency lighting shall be feb from UPS, self-contained type or a combination of these two.

2.6.7 For each area, the design philosophy of the emergency lighting shall be such that the installed system can be operated and maintained in a cost effective manner.

2.6.8 Self contained emergency lighting luminaires shall be manufactured in accordance with

IEC 60598-2-22 for the construction and performance of battery operated emergency lighting equipment.

2.6.9 The self-contained luminaires shall be of the non-maintained type incorporating an inverter control unit and sealed nickel cadmium battery pack of sufficient capacity to provide at least 50% normal illumination for a period of 2 hours upon mains supply failure.

2.6.10 A clearly visible charge operation/failure indicator and an integral switch shall be incorporated in each emergency luminaire in order to facilitate inspecting and testing.

2.6.11 UPS is designed to supply backup ac. electrical power from batteries to the following equipment in the event of total power failure:

2.6.12 Emergency lighting.

2.6.13 Ventilation fans in some hazardous rooms.

2.6.14 NOT USED

2.6.15 The number, capacity and disposition of the UPS to be provided shall take into account the size of the buildings and the location of the electrical loads.

2.6.16 UPS shall consist of a rectifier/charger section, an inverter section, an automatic load transfer switch and all necessary controls, and shall be provided with a battery bank of valve regulated lead-acid batteries.

2.6.17 UPS shall be compliant with below codes or standards.

2.6.18 IEC 60896-2-2 or ANSI T1.330 (R2002).

2.6.19 IEEE 1187.

2.6.20 Each UPS shall be supplied by two independent LV busbars at 415 V, three phase 3-wires, 50Hz.

2.6.21 The incoming supply changeover switch shall be provided at the upstream side of the UPS such that only one of the incoming supplies will be connected to the UPS input at any time. The other incoming supply shall act as a back up.

2.7 Cabling

2.7.1 Where control wiring is run in a conduit not readily accessible, or if the control wiring runs exceed 15m, then a minimum of 10% spare wires shall be run with the active wires.

2.7.2 The maximum continuous current-carrying capacity, the maximum permissible conductor temperature and the factors for determining such rating and temperature and physical protection for all cables shall be based on IEC 60287 and on the conditions anticipated in operation.

2.7.3 These conditions shall include, but not be limited to, the following:

i) ambient air temperature;

ii) duration for maximum short circuit current;

iii) permissible maximum voltage drop;

iv) voltage and frequency fluctuation;

v) harmonics content;

vi) grouping factor;

vii) presence of neutral current;

viii) unbalanced load conditions;

ix) power factor;

x) overload withstand ability;

xi) design current and growth;

xii) cyclic load;

xiii) installation method;

xiv) mechanical protection against attack by rodents for non-armoured cables

xv) chemical resistance;

xvi) ultra violet and infra red light resistance;

xvii) flammability;

xviii) electromagnetic interference screening; and

xix) resistance to effects of submersion in water.

2.7.4 All power and control cables in the project shall be FRLS cables complying with BS6724 or other approved standard for low corrosive and acid gas emission and IEC 60332-3 or other approved standard for flame retardence.

2.7.5 All insulated wires and cables within the stations of the Kolkata Metro East West Line shall be at least FRLSZH rated, and additional fire resistant or heat resistant rating shall be provided according to different load categorization and appliances.

2.7.6 All wires and cables shall be tested for compliance with the standards described below. Cables or wires in factory assembled equipment racks located in self contained and fire compartmented rooms are exempt from this requirement.

2.7.7 Flame Propagation Tests

i) IEC 60332-1 (Tests on electric cables under fire conditions. Test on a single vertical insulated wire or cable)

ii) IEC 60332-3 (Tests on electric cables under fire conditions, Category B. Test on bunched wires and cable)

iii) Oxygen and Temperature Index Tests

iv) ASTM D2863 (Measurement of Oxygen Index)

v) ASTM D2863 (Measurement of Temperature Index NES 715)

2.7.8 Smoke Emission Test

i) ASTM E622-79

ii) NBS Smoke Density Chamber Test. NFPA 258

2.7.9 Tests on Emitted Combustion Gases

i) UITP/APTA E8: Test of cable materials for corrosivity of combustion gases.

ii) IEC 60754-1: test on amount of halogen-acid evolved during combustion of electric cables (less than 0.5%)

2.7.10 General Type Test shall be IEC 60502, IEC 60811, IEC 60227-4..

2.7.11 The Contractor shall only propose the use of cables or wires that have been in use in comparable applications and shall have a service life expectation of at least 40 years.

2.7.12 Cabling shall be neatly run and fitted in brackets, trunking or conduit as may be appropriate to the layout and equipment.

2.7.13 The Contractor shall provide and install all supporting steelwork, brackets, clamps and other fixings necessary for the support of cables supplied under the Contract and all such items shall be fully galvanised.

2.7.14 Power cables serving equipment essential for emergency operations during fire conditions shall be fire resistant rating 740°C, 3 hours, cables designed to maintain circuit integrity under fire conditions and comply with the regulations of IEC 60331 and BS 6387 Category CWZ

2.7.15 Wires, cables and cable cores, which are individually terminated on terminal blocks, shall be individually identifiable. As an exception to this, in situations where radial daisy chain or ring main circuits are to be run in their own dedicated duct (e.g. lighting circuit), it shall be sufficient to identify the wires, cable or cable cores at the feed end only.

2.7.16 Cable identification shall be assembled from elliptical profiled plasticised PVC markers, carrier strip and nylon ties; the complete assembly shall be suitable for a maximum service temperature of 70°C.

2.7.17 Within equipment racks and equipment modules, all wires, cables, cable cores, terminal blocks and terminals shall be identified where practical to enable safe and efficient maintenance practice.

2.7.18 Cables through partition or floor openings, inside ducts or trunking shall have fire barriers or fire stopping sealant installed to maintain the required fire rating per UL1479.

2.7.19 Where control wiring is run in a conduit not readily accessible, or if the control wiring runs exceed 15m, then a minimum of 20% spare wires shall be run with the active wires.

2.7.20 Signalling, communications and other low voltage cables shall be run totally separately from high voltage power cables and shall, if necessary for the purposes of electromagnetic compatibility, have overall shielding and shielding of pairs.

2.7.21 A minimum separation of 300 mm shall be maintained through out the project.

2.7.22 The Contractor shall develop and submit for the Employer's approval a cable segregation philosophy setting out the intended segregation between different cable systems.

2.7.23 Any cables running underground, outdoors, along the track-bed, or installed indoors where having the possibility of being damaged by external force shall be armoured and shall have appropriate protection facilities.

2.7.24 For cables running along track-bed, adequate protection facilities against damage from being stood on by personnel shall be provided, and these facilities shall be neatly and firmly fixed to the track-bed such that they do not present a trip hazard to personnel.

2.7.25 Where cables have to cross the track, this shall be arranged so that the routing is perpendicular to the tracks.

2.7.26 dc cables shall be connected directly to the respective equipment.

2.7.27 Other connections from main cabling runs to equipment located on the trackside shall be made via disconnection boxes and tail cables.

2.7.28 Tail cables running along the track-side shall not have any jointing.

2.7.29 Conductors of power and control cables shall be copper complying with IEC 60228.

2.7.30 The Contractor shall submit for the Employer's approval a Code of Installation Practice for all cabling, wiring and termination activities which shall include details of tool calibration, testing and record keeping.

2.7.31 Joints in cable runs between stations shall not be permitted unless consent is given by the Employer on a case by case basis.

2.7.32 Any joints or connections in cable runs shall not be permitted within enclosed conduits and trunking.

2.7.33 Any joints and connections shall be located such that they are readily accessible for maintenance purposes.

2.7.34 The Contractor shall take all necessary steps to protect exposed cabling from deterioration due to the effects of solar ultraviolet and infrared radiation, and take into account any such degradation when sizing such cables.

2.7.35 Flexible cords shall be 450/750V grade and compliant with IEC 60227-5.

2.7.36 Flexible cords shall be multi-stranded copper conductors, high temperature, PVC insulated with flame retardant sheath.

2.7.37 The meaning of flame retardant in Lift & Escalator systems is that the following requirements shall be met:

i) flame spread index <25 per ASTM E84-1998

ii) smoke development index <50 per ASTM E84-1998.

iii) Complies with applicable IEC standards.

2.8 Cable Routes

2.8.1 Cables and wires shall be utilized and installed according to the local wiring code and NFPA 70 (NEC, 2005)

2.8.2 Cables shall be installed with a minimum of 300 mm clearance from any equipment or pipework including insulation associated with other services.

2.8.3 Cable routes for trackside cables and cable routes for cables within station structures and in the Depot shall be agreed with the Civil Infrastructure Contractors and/or Designated Contractors.

2.8.4 The 33kV ring-main feeder cables for the feed and return circuits shall be routed ‘under deck’ of UG stations.

2.8.5 Cables and wires for different load categorizations including non-essential, essential and critical/emergency loads, and for different applications including power, signals, communication, public address system, fire alarm and detection system, and others, shall be installed in separate cable routes.

2.8.6 If there is the backup circuit, it shall also be installed in the cable route which shall, as far as is practicable, be at least 3 meters horizontally distant from the normal circuit.

2.8.7 The ac and dc power cables shall be adequately separated to avoid interference affecting the signal and communication cables along the track and in stations.

2.8.8 Control and other cables routes shall be installed separately from both the dc traction supplies and ac power cables.

2.8.9 Cables shall be installed to ensure that any one cable can be removed without disturbance to other cables from different circuits within the same cable route.

2.8.10 Cables shall be identified by means of permanent markers located every 100 m along the length of the cable route, at the ends of the cable and at the point of entry into any room or duct.

2.8.11 All cable sheaths shall be earthed at their points of cable termination.

2.8.12 All enclosed cable ducts, including spare ducts, shall be sealed at each entry end with a fire retardant compound that is approved by the Employer.

2.8.13 All cables shall be installed and protected for the full length of the cable by means of cable trays, ducts, cable brackets, trunking and conduits.

2.8.14 Where cables are installed in vertical ducts or on vertical cable tray, they shall be cleated at intervals not exceeding 1,200 mm.

2.8.15 Where cables pass through fire-rated walls and floors all openings shall be sealed with fire resistant material of a fire rating equivalent to that of the fire rating of the walls or floors.

2.8.16 All structural fixings, cable brackets, cleats, ladders, trays and conduits shall be provided by the Contractor.

2.8.17 Drillings, fixing procedures and penetrations of the structures shall require to be agreed with the Civil Infrastructure Contractors and/or Designated Contractors and then be subject to the approval of the Employer prior to any work being carried out.

2.9 Cable Trays

2.9.1 The complete cable tray system shall be designed so that drilling shall not be necessary on site and cutting shall be kept to a minimum.

2.9.2 Metallic cable trays shall be compliant with NEMA VE-1 and cable trays shall be manufactured from mild steel and hot-dip galvanised per ASTM-A653 or other approved standard for general applications.

2.9.3 For corrosive hazardous areas, cable trays shall be manufactured from ASIS 316 stainless steel, or FRP made cable trays complied with below standards and codes should be provided.

i) NEMA FG 1-1998 – Non-Metallic Cable Tray Systems

ii) NFPA 70, Article 318.

2.9.4 Polyester resin material of FRP shall be zero halogen fire retardant compliant with UL 94 V0, and glass fibre reinforced plastic shapes shall meet ASTM E-84, Class 1 flame rating and self-extinguishing requirements of ASTM D-635.

2.9.5 Factory standard right-angle bends, tee junctions, off-set reducers, straight reducers shall be used for horizontal bends, vertical bends, branching out and reduction of cable ladder width.

2.9.6 Factory standard expansion splice plate shall also be provided to allow for expansion and contraction of the cable ladders.

2.9.7 All clamping nuts, bolts, washers, etc. shall be hot-dip galvanised.

2.9.8 Notwithstanding the above, complete cable ladder system shall be electrically continuous.

2.9.9 A tinned copper tape of size 25mm x 3mm minimum shall be installed along the cable ladder for earthing the exposed extraneous conductive parts nearby and for the purpose of equipotential bonding.

2.9.10 The cable trays shall be of sufficient width to accommodate the cables without crowding and shall allow for future cable additions to the proportion of 25% of Lift & Escalator Systems requirements.

2.9.11 Double stacking of cable shall not be allowed except where specifically approved by the Employer.

2.9.12 The cable trays shall be mounted using propriety made brackets, which shall in turn be attached to the structure.

2.9.13 The fixing brackets shall provide a rigid support of the cable trays and shall be installed to ensure a clear space is provided between the structure and/or obstructions and the back of the cable tray.

2.9.14 Cable tray systems shall be installed per NEMA VE-2, 2001, and NFPA 70, 2005.

2.10 Cable Trunking

2.10.1 Trunking and fittings shall comply with the provisions of IEC 61084 or other approved standard.

2.10.2 Under floor, skirting, wall trunking and high level ceiling trunking shall be provided in accordance with the highest standards, and shall be of the steel type with steel covers that are hot dip galvanised or zinc plated finish.

2.10.3 The lengths of trunking, bends, tee sections and offsets shall be coupled together by means of fish plates and bolted together using cadmium plated steel set screws, nuts and shake proof washers in accordance with the manufacturer's recommendations.

2.10.4 At each junction in the trunking it shall be ensured that electrical continuity is maintained, by means of additional copper links secured by brass nuts, locking washers and bolts.

2.11 Conduit

2.11.1 Steel conduits and fittings shall comply with the requirements of EN50086, IEC 60614 and 61035, or ANSI C80 and related and shall be of the screwed classification type.

2.11.2 The class of protection against corrosion shall be as defined in the schedule below, see Table 3. Conduit and fittings requiring 'Class 2' level of corrosion protection shall be finished in black enamel and conduit and fittings requiring 'Class 4' shall be, hot dipped galvanised.

2.11.3 Conduit boxes and covers shall include a minimum degree of protection as follows

Schedule of Corrosion Protection

	Location	Class of Protection against Corrosion Defined in EN 50086	Boxes and Covers Minimum Degree of Enclosure	Surface or Concealed
1	**Outside Buildings**	Class 4	IP 44	Surface
2	plant rooms and service ducts	Class 4	IP 41	Surface
3	switch rooms	Class 4	IP 41	Surface
4	ceilings voids	Class 4	IP 41	Surface
5	Buried	Class 4	IP 44	-
6	store rooms	Class 2	IP 41	Surface
7	all other locations	Class 2	IP 41	Concealed

2.11.4 The minimum nominal size of the conduit shall be 22 mm.

2.11.5 To satisfy requirements for earth fault loop impedance, the layout of conduit, trunking and ducting and routing of cables shall ensure that the maximum circuit lengths allowable are not exceeded.

2.11.6 Bending of conduit shall be performed without the use of heat, using the bending tools and accessories, in accordance with the manufacturer's recommended procedures.

2.11.7 Draw-in boxes shall be provided in conduit at the following maximum intervals:

i) straight run 15 m

ii) run with one or two bends 8 m

iii) run with three bends 4 m

iv) run with four bends 2.5 m

2.11.8 No conduit, when installed, shall be subject to any mechanical stress.

2.11.9 Where conduit is cast in situ, the conduit shall be securely fixed and is to incorporate draw wires before the concrete is poured.

2.11.10 As soon as shuttering or formwork is removed, the conduit shall be checked to ensure that no debris causing an obstruction or blockage has occurred during the casing process and the electrical continuity is maintained.

2.11.11 Temporary plugs shall be fitted to open ends of conduit and ducting to prevent ingress of water and solid material during and after the casting process.

2.11.12 At expansion and settlement joints, suitable provision shall be made in the conduit, trunking and ducting installation to allow for movement of the structure.

2.11.13 For trunking and ducting purpose-made expansion couplings shall be used.

2.11.14 All conduits, fittings, and accessories shall be installed per the local wiring regulation and NFPA 70, 2005.

2.12 Testing

2.12.1 All wiring system shall be tested per the local wiring regulation and International Electrical Testing Association (NETA) ATS, 2003.

2.12.2 Additional tests about earth loop impedance test, insulation test, RCD test, prospective short circuit current, and others requested by BS 7671, 16th Edition IEE Wiring Regulations, shall be in accordance provided.

2.13 Earthing System

2.13.1 All metal parts, other than those forming part of any electrical circuit shall be effectively connected in an approved manner to the main earthing system.

2.13.2 All control panels, with the exception of trainborne panels, shall be provided with continuous earth bars which shall run along the bottom of the panels for connection to the main earthing system.

2.13.3 The earth bars shall be of an approved cross-section.

2.13.4 Trainborne panels shall be provided with separate earth cables and looping of earths shall not be permitted.

2.13.5 Trunking and tray joints shall be connected with an external copper earth bonding link where necessary.

2.13.6 Grounding system and bonding system shall be compliant with IEC 60364, IEC 61312, IEC 61024, and the local wiring regulation.

2.14 Lightning Protection

2.14.1 Lightning protection shall conform as a minimum to the requirements of IEC 61024, IEC 61312, NFPA 780-2004, NFPA 70-2005, and the local Construction Technical Regulation.

2.14.2 The Contractor shall develop a lightning philosophy for the Kolkata Metro East West Line.

2.14.3 Different levels of lighting protection zone (LPZ) shall be configured appropriately according to the site condition of environment and the requirements of electrical surge and electromagnetic interference (EMI) protection.

2.14.4 Equipotential bonding shall be provided between the main ground network and all large or extensive extraneous metal objects not already bonded to ground by protective ground conductors not less than 16 mm2 except for PSG/PSD structures.

2.14.5 These shall include, but not be limited to the followings:

a. All external metallic service pipes.

b. Fire main pipes.

c. Ventilation ductwork.

d. Air conditioning ductwork Chilled water pipework.

e. Steel floor plates or metallic raised floor.

f. Station/substation lifting tackle.

g. Cable containment system.

h. Ceiling grid.

i. Window frame.

j. Handrails.

2.14.6 In each LPZ zone, the Contractor shall provide one main equipotential busbar connected to the grounding network via 2 runs of 100 mm2. grounding conductor for the implementation of single point bonding in a small area, or provide one conductor or busbar segments connected to the grounding network via 2 runs of 100 mm2. grounding conductor in order to form a loop along the inside boundary of a larger area for equipotential bonding.

2.14.7 Test facilities shall be provided for disconnecting down conductors at the earthing points to allow testing of individual earth points.

3 ELECTRICAL AND ELECTRONIC EQUIPMENT

3.1 Micro-Processors

3.1.1 When micro-processors are used to effect control of any equipment, the following requirements shall be met.

3.1.2 The microprocessor unit shall be constructed such that it can be mounted and electrical termination made during the construction stage of the project.

3.1.3 The microprocessor electronics shall be removable and added at a later stage i.e. during commissioning of the Kolkata Metro East West Line.

3.1.4 All control wiring and system communications shall be electrically terminated inside the microprocessor unit.

3.1.5 The microprocessor installation shall be designed to operate satisfactorily with variations from the normal values of voltage and frequency.

3.1.6 The equipment shall operate satisfactorily for steady state voltage variations from the normal values with the simultaneous frequency variation anticipated from the incoming supply.

3.1.7 Protection against any possible transient voltages and switching surges must also be incorporated in the design.

3.2 Solid State Hardware

3.2.1 When solid-state hardware is used, it shall meet the following requirements:

i) solid-state hardware shall be mounted on removable, printed circuit boards. Boards with edge connectors shall be gold plated at the connection points. The circuits shall be tin-lead-coated or otherwise protected from oxidation;

ii) all connections to the printed circuits on the printed circuit boards shall be made by properly dimensioned pads. No patched connections will be accepted; and

iii) the solid-state hardware shall be designed for a high level of noise immunity. Power supplies for, inputs to and outputs from the solid-state circuits shall incorporate electrical noise-suppression devices.

3.3 Accessories

3.3.1 All electrical devices such as circuit breakers, relays, contactors and switches shall comply with the requirements if IEC 60077 and shall be suitable for operation in a traction environment.

3.3.2 Control and auxiliary relays shall be of the plug-in type, rack-mounted or rail mounted, provided with cable connection sockets and anchored by quick fastening vibration-proof devices as far as practical.

3.3.3 Limit switches and other devices responsive to positional changes shall be of the metal-clad type with positive snap-action.

3.3.4 When micro-switches are used, the actuating mechanism shall be suitably designed to avoid the application of excessive force to the micro-switches whilst ensuring positive action in both directions and constancy of setting.

3.3.5 The switches shall be operated in either direction of movement by a positive mechanical drive and reliance shall not merely be placed upon springs forming part of the switch mechanism for the purpose of operation.

3.3.6 Switches and striking mechanism shall be readily accessible and individually adjustable and adequate means shall be provided to lock them in place on completion of all adjustments.

3.3.7 Control switches shall be subject to approval to ensure uniformity throughout. They shall be constructed, mounted and connected in such a way to facilitate maintenance without dismantling.

3.3.8 All control, interlock and alarm relays shall be mounted in positions that are readily accessible, unless otherwise approved and shall satisfy the requirements of IEC 60255.

3.3.9 Relays to be mounted on panels shall all be contained in dust proof cases suitable for flush mounting.

3.3.10 Metal bases and frames shall be earthed except where they must be insulated for special requirements.

3.3.11 Relay equipment shall where possible be arranged to be withdrawable and shall have positive means for retention in the service position.

3.3.12 All contacts for control and auxiliary equipment shall be adequately rated for their duty and subject to approval by the Employer.

3.4 Electric Motors

3.4.1 Electric motors shall be tested in accordance with IEC 60349.

3.4.1.1 Auxiliary motors shall be self cooled and totally enclosed with a motor enclosure with a degree of protection of a minimum of IP65.

3.4.1.2 Motor specification shall be such that temperature rise shall be restricted to one lower insulation class due to the high mean ambient temperatures experienced in Kolkata .

3.5 Terminal Blocks

3.5.1 Terminal blocks for control wiring shall be of a suitable rating and shall clamp the wire securely by a cage clamp system or between two plates secured by a captive screw. Terminal blocks shall have easily removable copper links to short circuit adjacent terminals or shall be fitted with suitable fuse and fuse holder where required.

3.5.2 Terminal strips or blocks at different voltages shall be segregated into groups, distinctively labelled and provided with permanent rigid barriers.

3.5.3 Open type terminals in groups that are not shielded by cubicle doors shall have separate flame retardant covers.

4 PAINTING AND CORROSION PROTECTION

4.1 General Requirements

4.1.1 This Clause describes the requirements for materials, methods of painting and painted identification and labelling of equipment, ducts, pipes, structural steelwork and other accessories.

4.1.2 All metal and steelwork shall be subjected to protective treatment.

4.1.3 All metal surfaces and steelwork other than stainless steel, plated carbon steel, anodised aluminium, copper alloy and other alloys having inherent corrosion resistant properties shall be painted.

4.1.4 Stainless steel shall be protected with a plastic coating during transport and installation.

4.1.5 Protective treatments shall be in accordance with the recommendations of ISO 12944, unless otherwise specified herein.

4.1.6 Prior to installation and assembly the Contractor shall submit to the Employer for approval, full details of the protective treatments it proposes to use.

4.1.7 For painting systems, the details shall include, but not be limited to:

i) name of paint manufacturer who has produced paint products for a period of at least ten years;

ii) place of manufacture of paint;

iii) surface preparation;

iv) method of application of each coat (i.e. brush, roller, spray);

v) nominal wet and dry film thickness for each coat;

vi) conditions under which paint will be applied i.e. shop or site and overcoating times; and

vii) manufacturer's data sheets giving the type and composition of each paint and giving any additional requirements e.g. pot life, storage or thinning requirements. The manufacturer's data shall also confirm the estimated design life of the protective system.

4.1.8 For each protective treatment other than a painting system, details appropriate to the protective system shall be submitted to the Employer for approval.

4.1.9 Protective treatments shall be designed for a maintenance-free life of five (5) years and such that only minor maintenance is required between five (5) and fifteen (15) years after first application.

4.2 Damage

4.2.1 Any damage caused to protective treatments during transportation, storage or installation shall be repaired in accordance with the manufacturer’s recommendations.

4.2.2 The Contractor may be required to repair the protective treatment for the whole of an item of damaged equipment if deemed necessary by the Employer.

4.2.3 If any equipment rusts due to an inadequate protective treatment or poor workmanship or incorrect handling during transportation, storage or installation, the Contractor shall be required at its own expense to replace all damaged parts or components and to reprotect the whole equipment including removal of all the existing protective treatment, chemical cleaning, rinsing and other necessary pre-treatment before applying a new protective treatment.

4.3 Painting

4.3.1 The following provisions shall apply where surfaces are to be painted.

4.3.2 Metal surfaces shall be dry and free of any contaminant such as dirt, dust, grease, oil, rust, wax or scale that would interfere with the development of full adhesion by the paint and coating system.

4.3.3 Proper procedures shall be followed, as outlined below and in consideration of the type and concentration of contaminants and the specific requirements of the protective coating system to be applied to any given surface. The Contractor shall follow strictly the surface preparation requirements as recommended by the paint manufacturers.

4.3.4 Surfaces that have been cleaned, pre-treated, dried or otherwise prepared shall be primed well before any deterioration of the prepared surface takes place.

4.3.5 The Contractor shall provide all chemical treatment, as necessary, before the application of the primer in order to achieve good adhesion of the paint to the substrate for the intended application.

4.3.6 The Contractor shall follow strictly all coating procedures recommended by the manufacturer of the coatings.

4.3.7 All safety rules and regulations, local laws and paint manufacturer's recommendations shall be strictly observed by personnel engaged in the storing, handling, use and application of paints, thinners and solvents so as to provide an acceptable level of safety from fire and health hazards.

4.3.8 Coatings and painting materials shall be delivered to the Works in their original unbroken containers plainly marked with the brand name and code of the product and the name of the manufacturer.

4.3.9 Coatings used shall be applied using a method recommended by the manufacturer without being extended or modified other than as provided for in the manufacturer's instructions.

4.3.10 Preparation and condition of all surfaces to be coated shall be as described in the manufacturer's instructions.

4.3.11 For ease of inspection and measurement, each successive coat applied to a surface shall be in such a tint as to make it easily distinguishable from the preceding coat.

4.3.12 All equipment which has been installed prior to cleaning and painting and not intended to be painted shall be protected during surface preparation and painting operations or shall otherwise be removed or repositioned upon completion of each area of work.

4.3.13 Paint shall not be applied in rain, high relative humidity or high temperatures as recommended by the manufacturer. Paints shall be applied under favourable conditions and carried out by skilled painters and under competent supervision.

4.3.14 Each coat of paint shall be allowed to dry thoroughly, not only on the surface but through the thickness of the paint film, before the next coat is applied.

4.3.15 Finished surfaces shall be uniform in finish, colour and even film thickness and free from finish spots, runs, sags and brush marks.

4.3.16 The total dry paint film thickness shall be as per the manufacturer's recommendations and shall be measured by an approved method.

4.4 Galvanising

4.4.1 Galvanising shall be applied by the hot dip process and shall consist of a smooth, clean zinc coating of uniform thickness and free from defects.

4.4.2 The zinc deposit density of the surface coating shall be not less than 1000g/sq. m of surface for structural steelwork and not less than 300 g/sq. m of surface for steel sheet and tested in accordance with the requirements of BS 729.

4.4.3 Materials required to be galvanised shall be thoroughly cleaned by either sand or grit blasting before applying galvanising.

4.4.4 Drilling, punching, tapping and bending of parts shall be completed and all burrs removed before galvanising. Welding after galvanising shall be avoided as long as it is practical to do so.

4.4.5 The preparation for galvanising and the galvanising itself shall not adversely affect the mechanical properties of the material being coated.

4.4.6 Surfaces that are normally in contact with oil shall not be galvanised unless otherwise specified.

4.4.7 Should welding after galvanising be unavoidable, welding on galvanised surfaces shall be continuous around the joint and shall be adequately treated with galvanising paint after completion to prevent corrosion and to the satisfaction and approval of the Employer.

4.4.8 The Contractor shall endeavour to protect bulky galvanised components from damage during transit. In the event of damage occurring, the Contractor shall undertake remedial action to the satisfaction of the Employer.

5 ELECTROMAGNETIC COMPATIBILITY

5.1 General Requirements

5.1.1 All Works provided by the Contractor shall be electromagnetically compatible with each other and shall also be electromagnetically compatible with all electrical and mechanical systems provided by the Rolling Stock Contractor, the Civil Infrastructure Contractors and/or all Designated Contractors and existing external systems which may affect or be affected by the works including radio systems, television systems, the telephone network, medical installations (fixed and mobile units such as heart pacemakers) and the power distribution network.

5.1.2 The electromagnetic compatibility of the works shall, as a minimum, comply with the requirements of European standard EN 50121.

5.1.3 The Contractor shall demonstrate to the Employer, the compliance of the works with the requirements of European standard EN 50121 as part of the design, type testing, testing on site and final commissioning.

5.1.4 All equipment provided by the Contractor shall be adequately designed to be immune to all electromagnetic interference that could arise, according to the requirements of European standard EN 50121.

5.1.5 Failure of any electromagnetic suppression components fitted to safety critical systems provided by the Contractor shall not cause that equipment to fail and cause an unsafe condition on the Kolkata Metro East West Line, when it is subjected to interference that is within the bounds of the EN 50121.

5.1.6 The Contractor shall identify all systems and equipment to be tested, define the test procedure and provide acceptance criteria that must be achieved. The Contractor shall carry out EMC compliance testing in the FAT stage and verification testing in the commissioning stage of the project on these systems and equipment.

5.1.7 For theoretical analysis, the Contractor shall detail the process and methods used for verification and validation of any simulation models used in support of the analysis, where applicable. The Contractor shall prepare and submit to the Employer for review reports of the verification and validation of the models. The Contractor shall verify all results by one or more of the following means,

(i) use of certified simulation models; and

(ii) on-site verification tests.

5.1.8 The Contractor shall interface, liaise, co-ordinate and exchange EMC data with all relevant Project Contractors to ensure EMC integrity in the design stage, and to appropriately demonstrate compatibility in the testing and commissioning stage of the project in conjunction with these Project Contractors. The Contractor shall send a copy of all EMC related information exchange to the Employer for review.

5.1.9 The Employer may request, at his discretion, attendance at the EMC tests prior to delivery, to ensure that the EMC requirements are met. However, this will not result in design acceptance which can only be given after successful completion of the testing and commissioning.

5.1.10 The Contractor shall implement corrective measures and actions to rectify any EMC problems identified during design, on-site tests, trial operations and within the Defects Liability Period.

6 SOUND REDUCTION AND VIBRATION ELIMINATION

6.1 General Requirements

6.1.1 Equipment shall be quiet in operation and noise output shall comply with the standards described in the Specification. Sound reducing rubber pads, shock absorption buffers, acoustic fibreglass lining or other means shall be provided where necessary to eliminate vibration and noise transmission.

6.1.2 Thermal and acoustic materials used shall not absorb liquids or gases and shall possess the required properties to meet noise, vibration and thermal limits recommended by AWS or other approved standard.

6.1.3 The Contractor shall provide comprehensive control of noise and vibration from all equipment.

6.1.4 Detailed proposals for noise and vibration control shall be submitted for approval.

7 LABELLING

7.1 General Requirements

7.1.1 This Clause describes the requirements for materials and methods of labelling of all equipment, ducts, pipes and other accessories.

7.1.2 Labels shall be written in Hindi, Bengali and English for identification purposes.

7.1.3 Labels shall have black letters permanently engraved, stamped or cast, on a white background.

7.1.4 Labels shall be made of materials that meet the fire requirements.

7.1.5 Labels shall be permanently attached to the associated equipment for the life of the equipment. Labels shall be mounted in such a position that they can be easily seen from the usual point of access.

7.2 Nameplates

7.2.1 Nameplates shall be securely attached to each piece of equipment showing the manufacturer's name, model type reference (including version number), serial number, rating, power factor, etc.

7.2.2 Rotating machines shall carry a rating plate with at least:

a) current and voltage ratings and whether continuous;

b) speed at rated voltage;

c) maximum speed; and

d) winding connection.

7.2.3 Uni-direction rotating machines shall carry an arrow showing the current direction of rotation.

7.2.4 Equipment enclosures containing equipment where the voltage potential to earth exceeds 110V shall be clearly marked with a ‘DANGER’ sign, the voltage and type of supply (ac or dc) and also instructions to isolate before removing the cover.

7.2.5 For equipment containing stored energy devices, a warning label shall be fitted. The warning label shall provide the safe minimum discharge time.

APPENDIX 1

PROGRAMME

1 Time-Scaled Network/Bar Chart

1.1 All programmes shall be developed by computerised Critical Path Method (CPM) using the Precedence Diagramming Method (PDM) and shall be presented in either bar chart or time-scaled network diagram format, suitably coloured to enable easy reading. All duration for the purpose of programming shall be in calendar days. All reference to network shall mean time-scaled network unless otherwise specified.

1.2 The first two alphanumeric characters of any activity ID, known as the sub-project ID shall use only those prescribed in Table 2A. The activity ID code structure is illustrated in Table 2A.

1.3 The coding structure shall be such that the activities can be summarised to various levels. Each level shall be summarised and collapsed to the next level using the programming software. The Employer may require additional activity codes subject only to restrictions imposed by the programming software. Additional codes where necessary may be created by the Contractor with the approval of the Employer. Each activity in the network shall be coded, as a minimum, with the following:

(i) Contract number, activity type, and unique identification numbers.

(ii) Activity codes to indicate Unit, Segment, Stage or Phase, for e.g. design, manufacturing, delivery, installation, etc.

(iii) The Contractor shall note that breakdown of system into sub-systems is essential and shall be carried out not through further coding but through activity descriptions in a consistent manner such as to allow storing. However, the Employer shall have the right to require the Contractor to code sub-systems, using codes approved by him, if necessary.

(iv) Area, location and location details under Activity Code – Unit.

(v) Cost and resources

(vi) Cost and resources codes shall be submitted for the approval of the Employer.

1.4 All logical and necessary relationships between activities shall be shown.

1.5 All Key Datesindicated in the Contract shall be shown.

1.6 The level of programme development, information and detail shall be sufficient to permit the Employer to have a good appreciation of the Contractor's project management plan especially with regard to the co-ordination and timing of his work in relation to the work of the Designated Contractors and the obtaining of necessary approvals from the relevant local authorities. It shall demonstrate ability to meet all key dates through a logical work sequence that has taken account of the Project constraints.

1.7 Activities pertaining to review/acceptance by the Employer and local authorities shall be identified. Where duration for review of the Contractor's submissions are specified elsewhere in the Contract, they shall be used. Where they are not specified, a duration of 30 days for review of each submission shall be used.

1.8 Activities outside the scope of the Contract that may affect the Contractor's progress

shall be shown.

1.9 The activity network shall be organised so that major work sections are carefully co-ordinated with the Civil Contractor and the System-wide Contractors to allow opportunity for all to work with as minimal disruption as possible.

1.10 Critical paths shall be identified.

1.11 Activity descriptions shall convey the nature and scope of the work. Uncommon abbreviations shall be explained in the legend. Float time shall be shown for all activities in the programme.

1.12 The CPM Network Diagram shall be developed to permit modification to the schedule and allow for impacts on the schedule to be analysed by introduction of"what if" statements into the input data.

1.13 The programme shall be prepared in accordance with the Employer's requirements and be fully quantified and multi-resourced in terms of, for example; manpower, numbers of drawings, numbers of equipment items, cable lengths as appropriate, covering all stages of the Contract and demonstrating how the Contractor plans to execute the Contract scope in order to achieve the requirements of the Key Dates.

2 Time Scaled Network/Bar Chart Details

2.1 Design

The Design network/bar chart shall detail the various design, submission and acceptance stages including approval by local authorities and the Employer, preparation, submission and approval of drawings, manuals and all other activities related to the design.

2.2 Manufacturing

The manufacturing network chart shall indicate the relationship and duration of the activities necessary to procure, fabricate manufacture, assemble equipment / complete car tests, ship and deliver the equipment comprising the Works in time to support the activities at site. Major areas of work shall be shown as separate and distinct activities. The network shall also cover activities of Sub-Contractor as appropriate, including testing.

2.3 Testing and Commissioning

The Factory and On Site Testing and Commissioning network/bar chart shall present the relationship and duration of those items relating to Commissioning tests including those related to Designated Contractors. The network/bar chart shall present testing approach to be used, the deployment of resources in accordance with equipment delivery dates.

2.4 Not used

2.5 Integrated Testing

The Integrated Testing network/bar chart shall indicate the activities required to verify the functioning of the equipment comprising the Works in conjunction with activities of the System-wide and Civil Contractors.

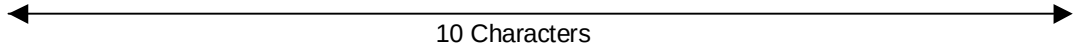
2.6 Trial Runs

After completion of Commissioning, the Contractor shall be required to carry out trial running.

The network/chart shall indicate tests, measurements and interface tests required to be carried out to verify system performance and readiness for revenue service.

TABLE 2A: ACTIVITY ID CODE STRUCTURE

Activity ID Code



A	A/N	A	A/N	N	N	N	N	N	N
2		**2**		**2**		**4**			
Contract No., e.g. SI for Signalling & Train Control System Contract		Unit Nos. for Location Nos. for Stations or Line Segment 1		Activity Type Related to type of work with reference to Contractual Service Index numbers for civil disciplines		Unique Identification Number in increments of e.g. 1000, 1010, etc. Legend: A = Alphabetic A/N = Alpha-Numeric N = Numeric			

Activity Codes:

Each Activity, in addition, shall be assigned Activity Codes.

The Contractor shall collect the different contract details and station names etc. and suitable code shall be developed for it during the execution of the Contract.

2.7 Tasks in the Works Programme shall be sufficiently detailed to describe activities and events that include, but are not limited to, the following:

a) Access Dates;

b) all physical work to be undertaken in the performance of the Contract;

c) the requested date for issue of any drawings or information by the Employer;

d) the principal aspects of the design submission programme;

e) the manufacture of equipment or components;

f) the assembly of the equipment comprising the Works;

g) factory testing of the equipment comprising the Works;

h) interface periods with Civil Infrastructure Contractors and/or Designated Contractors or Relevant Authorities;

i) design and/or installation activities of Sub-contractors;

j) testing on site of the equipment comprising the Works;

k) integrated testing of the Works with the Kolkata Metro East West Line infrastructure

and;

l) any outside influence which will or may affect the Works.

2.8 The Works Programme shall show achievement of Milestones and Key Dates and the Date for Revenue Service.

2.9 Not used.

2.10 Activity descriptions shall clearly convey the nature and scope of the Works. Programme shall take into account, where appropriate, the activities of subcontractors, utility companies, contractors on adjacent sites, Designated Contractors and any other activities which may affect progress of the Works. The Contractor shall also incorporate the Engineer's requirements for additional activities.

2.11 Programme activities shall be discrete items of work which, when complete, produce definable, recognisable elements, specified parts and clearly identify the achievement of Key Dates within the Contract.

2.12 Any activity creating an imposed time or other constraint shall be fully defined by the Contractor.

2.13 The Works Programme shall be organised in a logical work-breakdown-structure including work stages and phases, and shall clearly indicate the critical path(s).

2.14 Each activity in the Works Programme shall be coded to indicate:

a) work groups responsible for the activity including identification of Contractor or Sub-contractor,

b) area, facility or location; and

c) Cost Centre work item.

2.15 Activity durations shall not exceed three months except as approved by the Employer and shall be expressed in days.

2.16 The Contractor shall submit a programme/project calendar cross-reference clearly indicating the allowance for holidays.

2.17 The Works Programme shall be accompanied by an activity report and a narrative statement, all in both electronic format and hard copy (time scale logic diagrams in colour plot A3 size, reports in A4 size).

2.18 The activity report shall list all activities, and events in the Works Programme, sorted by activity identification number.

2.19 The activity report shall include the following for each activity and event:

a) activity identification number and description;

b) duration expressed in days;

c) early and late start and early and late finish dates; planned start and finish dates;

d) calculated total float and free float;

e) predecessor(s) and successor(s), accompanying relationships and lead/lag duration;

f) imposed time or date constraints, and

g) calendar.

h) resources

2.20 The narrative statement shall include the following:

a) A narrative identifying the basis of the Contractor's determination of activity durations, strategy of the installation work, programme assumptions such as staffing, shiftworking, hours of work, Approval times and methods to be employed in completing the Works.

b) The Contractor shall identify shift patterns, differentiate between logic constraints which are resource constraints and constraints which are pure logic. The Contractor shall identify and substantiate on a case by case basis to the Engineer's satisfaction any fixed target starts or finishes or artificial constraints.

2.21 It shall explain fully the reasons for the main logic links in the Works Programme and include particulars of how activity durations are established.

2.22 All submissions of proposed Works Programmes subsequent to approval of the initial Works Programme shall include the actual physical progress of work and forecast of work remaining.

2.23 Actual progress shall be stated in percent complete, remaining duration and actual start dates and actual finish dates for each activity in the Works Programme.

2.24 Once each month during the progress of the Works or at such other intervals as may be required by the Employer, the Works Programme, activity report and narrative statement shall be reviewed and updated by the Contractor taking into account the latest available information on activities completed, in progress and not yet started, which information shall be agreed with the Employer.

2.25 The updated Works Programme, report and narrative statement shall be submitted to the Employer indicating the state of progress of the Works and the revisions necessary to achieve the Date for Revenue Service.

2.26 The Three Month Rolling Programme shall be an expansion of the current Works Programme, covering sequential periods of three months.

The window for the Three Month Rolling Programme shall commence one (1) month prior to the "Time Now" for the purpose of showing progress achieved or delays incurred by the Contractor during the previous month, together with his detailed plan of work for the period from "Time Now" until "Time Now plus three (3) months".

2.27 The Three Month Rolling Programme shall provide more detail of the Contractor's plan, organisation and execution of the Works within these periods.

2.28 In particular, the Contractor shall expand each activity planned to occur during the three month period, if necessary to a daily level of detail.

2.29 The Three Month Rolling Programme shall where applicable be developed as a critical path method (CPM) network, and shall be presented on electronic media in bar chart and time-scaled network diagram format.

2.30 Bar charts shall be presented in either colour or black and white on A4 media, and time-scaled networks diagrams in colour on A3 size media.

2.31 Tasks in the Three Month Rolling Programme shall be derivatives of and directly related to tasks in the approved Works Programme.

2.32 The Contractor shall describe the discrete work elements and work element inter-relationships necessary to complete all work and any separable parts thereof including work assigned to Sub-contractors.

2.33 Activity durations in the Three Month Rolling Programme shall not exceed two (2) weeks unless approved in advance by the Employer.

2.34 Each activity in the Three Month Rolling Programme shall be coded or described so as to indicate clearly the corresponding activity in the Works Programme.

2.35 The Three Month Rolling Programme shall be extended forward each month as described above.

2.36 Each submission of the Three Month Rolling Programme shall be accompanied by a programme analysis report, describing actual progress to date, and the forecast for activities occurring over the three-month period.

2.37 If the Three Month Rolling Programme is at variance with the Works Programme, the programme analysis report shall be accompanied by a supporting narrative statement describing the Contractor's plan for the execution of the activities to be undertaken over the three month period, including programme assumptions and methods to be employed in achieving timely completion.

2.38 The Contractor shall revise the Three Month Rolling Programme or propose revisions of the Works Programme, or both, from time to time as may be appropriate to ensure consistency between them.

APPENDIX 2

MONTHLY PROGRESS REPORT

1 Contract Stages

1.1 General

The Contractor shall submit to the Employer, a Monthly Progress Report. This Report shall be submitted by the end of each calendar month and shall account for all work actually performed from 26th day of the last month and up to and including the 25th day of the month of the submission. It shall be submitted in a format to which the Employer shall have given his consent and shall contain sections/sub-sections for, but not be limited to, the topics listed in clauses 2 to 10 below.

2 Financial Status

2.1 A narrative review of all significant financial matters, and actions proposed or taken in respect to any outstanding matters.

2.2 A spread sheet summarising each Cost Centre, the budget, costs incurred during the period, costs to date, costs to go, cost forecast (total of costs to date and costs to go) and cost variance (difference between cost forecast and budget).

2.3 A spread sheet indicating the status of all payments due and made.

2.4 A report on of the status of any outstanding claims. The report shall in particular provide interim updated accounts of continuing claims.

3 Physical Progress

3.1 It shall describe the status of work performed, significant accomplishments, including critical items and problem areas, corrective actions taken or planned and other pertinent activities, and shall, in particular, address interface issues, problems and resolutions.

3.2 It shall include a simplified representation of progress measured in percentage terms compared with percentage planned as derived from the Works Programme.

4 Programme Update (For Entire Project)

4.1 Programme updating shall include:

(i) The monthly Programme Update which shall be prepared by recording actual activity completion dates and percentage of activities completed up to the twenty-fifth (25th) of the month together with estimates of remaining duration and expected activity completion based on current progress. The Programme Update shall be accompanied by an Activity Report and a Narrative Statement. The Narrative Statement shall explain the basis of the Contractor's submittal:

(a) Early Work and Baseline Submittals – explains determination of activity duration and describes the Contractor's approach for meeting required Key Dates as specified in the Contract.

(b) Updated Detailed Programme Submittals – state in narrative the Works actually completed and reflected along Critical Path in terms of days ahead or behind allowable dates. Specific requirements of narrative are:

If the Updated Detailed Work Programme indicates an actual or potential delay

to Contract Completion date or Key Dates, identify causes of delays and provide explanation of Work affected and proposed corrective action to meet Key Dates or mitigate potential delays. Identify deviation from previous month's critical path.

Identify by activity number and description, activities in progress and activities scheduled to be completed. Discuss Variation Order Work Items, if any.

(ii) the Programme Status which shall:

(a) show Works Programme status up to and including the current report period, display cumulative progress to date and a forecast of remaining work.

(b) be presented as a bar-chart size A3 or A4 and as a time-related logic network diagram on an A1 media, including activity listings;

(iii) the Activity Variance Analysis which shall analyse activities planned to start prior to or during the report period but not started at the end of the report period as well as activities started and/or completed in advance of the Works Programme.

5 Key Dates Status

5.1 A report on the status of all key datesdue to have been achieved during the month and forecasts of achievement of any missed Milestones, and those due in the next month.

6 Three Month Rolling Programme

6.1 The monthly issue of the Three Month Rolling Programme.

7 Planning And Co-Ordination

7.1 A summary of all planning/co-ordination activities during the month and details of outstanding actions.

7.2 A schedule of all submissions and consents/approvals obtained/outstanding.

8 Procurement Report

8.1 A summary of all significant procurement activities during the month, including action taken to overcome problems.

8.2 A report listing major items of plant and materials, which will be incorporated into the Works. The items shall be segregated by type as listed in the Specifications and the report should show as a minimum the following activities:

(i) purchase Order Date - Scheduled/Actual,

(ii) manufacturer/Supplier and Origin,

(iii) letter of Credit Issued date,

(iv) manufacturer/Supplier Ship Date - Scheduled/Actual,

(v) method of shipment,

(vi) arrival date in India- Scheduled/Actual.

9 Production And Testing

9.1 A review of all production and manufacturing activities during the month.

9.2 Summaries of all production and manufacturing outputs during the month together with forecasts for the next month.

9.3 Review of all testing activities (both at site or at the manufacture's premises) during the month

10 Safety

10.1 A review of all safety aspects during the month including reports on all accidents and actions proposed to prevent further occurrence.

11 Environmental

11.1 A review of all the environmental issues during the past month to include all monitoring reports, mitigation measures undertaken, and activities to control environmental impacts.

APPENDIX 3

KEY DATES

Please refer to key dates contained within the Conditions of Contract.

APPENDIX 4

DRAFTING AND CAD STANDARDS

1. Introduction

1.1 The purpose of this document is to define the minimum Drafting and CAD standard to be achieved by the Contractor for all drawings produced by the Contractor for the purpose of the Works.

1.2 By defining a common format for the presentations of drawings and CAD files, the exchange of drawn information is improved and will maximise the use of CAD in the co-ordination process.

1.3 All submissions shall be made to the Employer's Requirements in a format reviewed without objection by the Employer and in accordance with the requirements in:

(i) the Contract;

(ii) the Document Submittal Instructions to Consultants and Contractors.

1.4 Paper and drawing sizes shall be “A” series sheets as specified in BS 3429.

1.5 The following software compatible for use with Intel-Windows based computers shall be used, unless otherwise stated, for the various electronic submissions required:

Document Type	Electronic Document Format
Text Documents	MS office 2000 Professional
Spread Sheets	MS office 2000 Professional
Data Base Files	MS office 2000 Professional
Presentation Files	MS office 2000 Professional
Programmes Ver 2.0a	Primavera for Windows, Ver. 2.0b, Suretrack
AutoCAD Graphics	AutoCAD 2004
Photographic	Adobe Photoshop, Ver.4.0
Desktop Publishing	Page Maker 6.5,5
CADD Drawings	AutoCAD 2004

1.6 Media for Electronic File Submission

One copy shall be submitted unless otherwise stated in CD-ROM.

1.7 Internet File Formats/Standards

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

(ii) All the data formats or standards must be supported by Microsoft Internet Explorer version 6 or above running on Windows NT and Windows XP.

(iii) The following lists the file types and the corresponding data formats to be used on the Internet. The Contractor shall comply with them unless prior consent is obtained from the Employer' for a different Data format:

File Type	Data Format
Photo Image	Joint Photographic Experts Group (JPEG)
Image other than Photo	GIF or JPEG
Computer Aid Design files (CAD)	Computer Graphics Metafile (CGM)
Video	Window video (.avi)
Sound	Wave file (.wav)

1.8 The following states the standards to be used on Internet when connecting to database (s). The Contractor shall comply with them unless prior consent is obtained from the Employer for a different standard:

Function to be Implemented	Standard to be Complied With
Database connectivity	Open Database Connectivity (ODBC)
Publishing hypertext language on the World Wide Web	Hypertext Markup Language (HTML)

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

2. General Requirements

2.1 General

2.1.1 The Contractor shall adopt a title block similar to that used in the Drawings for all drawings prepared under the Contract.

2.1.2 Each drawing shall be uniquely referenced by a drawing number and shall define both the current status and revision of the drawing.

2.1.3 The current status of each drawing shall be clearly defined by the use of a single letter code as follows:

D - Definitive Design Drawing

M - As Manufactured Drawing

B - As-Built Drawing

E - The Employer's Drawing

2.2 Drawing Numbering System

2.2.1 A suitable drawing numbering systems shall be evolved by the Contractor and submitted to the Employer for his review. It shall present unique numbers and take care of revisions.

2.3 Types of Drawing

2.3.1 'Design drawings' mean all drawings except shop drawings and as-built drawings.

2.3.2 'Working drawings' are design drawings of sufficient detail to fully describe the Works and adequate to use for construction or installation.

2.3.3 "Site drawings and sketches' are drawings, often in sketch form, prepared on site to

describe modifications of the Working drawings where site conditions warrant changes that do not invalidate the design.

2.3.4 'Shop drawings' are special drawings prepared by the manufacturer or fabricator of various items within the Works to facilitate manufacture or fabrication.

2.3.5 'As-built drawings' show the Works exactly as constructed or usually prepared by amending the working drawings to take into account changes necessitated by site conditions and described in Site drawings. These drawings shall be completed on a regular basis as the works progress, and shall not be left until completion of the entire works.

3 Computer Aided Design & Drafting (CAD) Standards

3.1 Introduction

3.1.1 Scope of Use

Data input procedures between the Employer and the Contractor must be co-ordinated, and the key parameters used to form CAD data files must be standardised. The production of all CAD data files shall comply with the following requirements.

3.2 Objectives

3.2.1 The main objectives of the CAD standards are as follows:

(i) To ensure that the CAD data files produced for Project are co-ordinated and referenced in a consistent manner.

(ii) To provide the information and procedures necessary for a CAD user from one discipline or external organisation to access (and use as background reference), information from a CAD data file prepared by another discipline or external organisation.

(iii) To standardise the information contained within CAD data files which may be common to more than one discipline such as drawing borders, title boxes, grid lines etc.

(iv) To establish procedures for the management of CAD data files.

(v) To ensure all contractors use 'Model space' and 'Paper space' in the production of their CAD files'.

3.3 General

3.3.1 To facilitate co-ordination between contractors, it is a requirement that all drawings issued by the Contractor for co-ordination or record purposes shall be produced using CAD methods. Drawings shall be issued in digital format in addition to the paper copies.

3.3.2 The intent of the issue of digital information is to aid the related design by others. The definitive version of all drawings shall always be the paper or polyester film copies which have been issued by the Contractor or organisation originating the drawing.

3.3.3 Drawings and drawing packages issued for co-ordination, record purposes or for

acceptance shall be accompanied by a complete set of the corresponding CAD data files.

3.3.4 Any contractor or organisation making use of the CAD data from others shall be responsible for satisfying himself that such data is producing an accurate representation of the information on the corresponding paper drawing which is satisfactory for the purpose for which he is using it. Provided the general principles of this section have been achieved by the originator of the CAD data, contractors making use of the CAD data from others shall not be entitled to require alterations in the manner in which such CAD data is being presented to them.

3.3.5 In particular, automatic determination of physical dimensions from the data file shall always be verified against the figured dimensions on the paper or polyester drawings. Figured dimensions shall always be taken as correct where discrepancies occur.

3.4 Terminology & Associated Standards / Guidelines

3.4.1 Any terminology used within this section that is ambiguous to the user shall be clarified with the Employer'. British Standard BS1192 is used in principle as a guide for drawing practice, convention, CAD data structure and translation.

3.5 Paper Drawings

3.5.1 For the Project “Paper” drawings are considered to be the main vehicle for the receipt and transmittal of design and production information, typically plans, elevations and sections.

3.5.2 The Project wide accepted media for the receipt and transmittal of “Paper” drawings will be paper and polyester film of various standard ISO ‘A’ sizes. The composition of this information shall be derived from a CAD “Model”.

3.5.3 The CAD derived “Paper” drawing composition will reflect a window of information contained within a CAD “Model Space” file together with a selection of information contained within the associated CAD “Paper Space” file.

3.6 CAD Data Creation, Content & Presentation

3.6.1 A consistent method of CAD data creation, together with content and presentation is essential. The method of CAD “Model Space and Paper Space” creation is as follows:

(i) Model Space Files

Typically CAD “Model Space” files are required for general arrangement and location plans and will consist of a series of other “Model Space” referenced CAD files covering the total design extents at a defined building level (the number of referenced files should be kept to an absolute minimum). Data contained within a CAD “Model Space” files is drawn at full size (1:1) and located at the correct global position and orientation on the Project Grid / or defined reference points.

Each CAD “Model Space” file will relate to an individual discipline. Drawing border / text, match / section lines or detailed notation shall NOT be included within a CAD “Model Space” file. Dimensions shall be included within a CAD “Model Space” but located on a dedicated layer. Elevations, Long Sections and Cross Sections shall also be presented in CAD “Model Space” as defined above, but do not need to be positioned and orientated on the Project Grid.

(ii) Paper Space CAD Files

Paper Space" CAD files are utilised to aid the process of plotting "Paper" drawings and are primarily a window of the CAD "Model Space" file. A "Paper Space" CAD file will typically contain drawing borders, text, match or section lines & detailed notation. Once these files are initially set up and positioned, the majority of

"Paper Drawing" plots at various approved scales are efficiently and consistently generated by displaying different combinations of element layers and symbology contained within the "Paper Space" file and the referenced "Model Space" files. The purpose is to ensure that total co-ordination is achieved between the CAD

"Model Space" file and the "Paper Drawing" output during the revision cycle of the design and production process. Duplicated data in "Model and Paper Space" files will not be acceptable unless an automatic update link exists between the two data sets. "Paper Space" files are not typically required as part of the CAD Media Receipt from contractors, unless specifically requested.

3.7 CAD Quality Control Checks

3.7.1 Random CAD Quality Control Audits will be carried out by the Employer on all CADmedia received and transmitted.

3.7.2 These checks DO NOT verify the technical content of the CAD data received or transmitted (as this is the responsibility of the originating organisation), however compliance with Project CAD and Drafting Standards shall be checked.

3.7.3 In addition, all contractors who transmit and receive CAD data from the Project shall have CAD quality control procedures in place. A typical quality control procedure shall contain CAD data quality checking routines coupled with standards for CAD data transmittal and archiving.

3.8 CAD Data Transfer Media and Format

3.8.1 When CAD data is received & transmittal between the Employer and the Contractor, the media shall be as follows:

(i) Data Exchange Format - AutoCAD 2004 (.DWG).

(ii) Operating System - / Window NT / Windows XP.

(iii) Data Transfer Media:

(a) DVD Disc

(b) Compact Disc (650 MB) is highly preferred

(c) Portable SCSI hard disk (return to the Contractor upon data transfer) with software

(d) All storage media must be labelled on the data shield with:

(i) Name of Company

(ii) Project Title

(iii) Drawing Filenames

(iv) All media shall be submitted with a completed Form (CAD Disk)

(v) The Contractor must ensure the supplied media is free from virus.

3.9 CAD Media Receipt & Transmittal

3.9.1 CAD Media Transmittal (from the Contractor to the Employer) - this will consist of the following:

(i) CAD Digital Media (disk(s), CD's or tape (s)) shall typically contain CAD "Model Space" and "Paper Space" files.

(ii) CAD data sheet

(iii) CAD issue / revision sheet

(iv) CAD Quality Checklist confirming compliance.

(v) Plot of each "Model Space" file issued on an A1 drawing sheet (to best fit).

3.9.2 The above CAD media will be collectively known as "CAD Media Transmittal Set". The CAD data file transmittal format required by the Employer from all contractors shall be in AutoCAD 2004 format.

3.9.3 All CAD media received from contractors will be retained by the Employer except for SCSI disk (if used) as an audit trail / archive of a specific contractor's design evolution.

3.9.4 CAD Media Receipt (from the Employer to the Contractor)

(i) CAD media should normally be obtained from the respective other contractor(s), but should the Employer issue CAD media it will consist of the following:

(a) CAD Digital Media disk(s) or tape(s) typically contain only CAD "Model Space" files.

(b) CAD data sheet.

(c) CAD issue / revision sheet

(ii) The above CAD media will be collectively known as the "CAD Media Receipt Set". The CAD data file transmittal format used by the Employer to all contractors will be in AutoCAD 2004 format.

(iii) Each CAD transmittal disk / tape will be labelled with proper disk label as approved by the Employer. Any CAD data transmitted without this label is assumed to be provisional information not to have been quality checked and therefore not formally issued.

3.10 Revisions

3.10.1 All 'Revisions', 'In Abeyance' and 'Deletions' shall be located on a common layer. This layer can be turned on or off for plotting purposes.

3.10.2 The following example text indicates the current CAD file revision, i.e. 'Revision [A]'. This shall be allocated to a defined layer on all CAD "Model Space" files, in text of a size that will be readable when the CAD "Model Space" file is fitted to the screen, with all levels on.

3.11 Block Libraries, Blocks, & Block Names

3.11.1 All Construction Industry symbols produced as CAD Cells shall typically conform to British Standard BS1192 - part 3.

3.11.2 All Blocks created shall be Primitive (i.e. NOT Complex) and shall be placed Absolute (i.e. NOT Relative).

3.11.3 The Contractor's specific block libraries shall be transmitted to the Employer together with an associated block library list containing the filename (max. 6 characters) and block description. The Contractor shall ensure that the library is regularly updated and circulated to all other users, together with the associated library listing.

3.11.4 All Blocks of a common type, symbols or details should initially be created within a CAD "Model Space File" specifically utilised for that purpose. These files will be made available on request by the Employer.

3.11.5 All Blocks created will typically be 2D unless 3D is specifically requested. In both instances they shall have an origin at a logical point located within the extents of each Block's masked area or volume.

3.12 CAD Dimensioning

3.12.1 Automatic CAD Dimensioning will be used at all times. Any dimensional change must involve the necessary revision to the model space file. If the CAD Quality Control Checks find that the revisions have not been correctly carried out, the rejection of the entire CAD submission will result.

3.13 CAD Layering

3.13.1 All CAD elements shall be placed on the layers allocated for each different discipline. The layer naming convention to be adopted by the Contractor shall be submitted for acceptance and inclusion within these standards.

3.14 Global origin, Location & Orientation on the Alignment Drawing.

3.14.1 Location or Plan information in "Model Space" files shall coincide with the correct location and orientation on the Project grid for each specific contract.

3.14.2 Location plans shall have at least three setting out points shown on each CAD "Model Space" file. Each setting out point shall be indicated by a simple cross hair together with related Easting and Northing co-ordinates. The Civil Contractor(s) will establish the three setting out co-ordinates for their respective works, which will then be used by all other contractors including the Contractor.

3.15 Line Thickness and Colour

3.15.1 Suitable line thickness and colour shall be used.

3.16 CAD Utilisation of 2D & 3D Files

3.16.1 Although the project standard is 2D CAD files, certain disciplines and contractors may use 3D CAD files for specific applications or where the isolated use of 3D aids the design and visualisation process (i.e. Architecture, Survey and Utilities). In these specific instances 3D CAD data will only be transmitted if all other users can use this data. If this is not the case, a 3D to 2D translation shall be processed by the creator prior to issue.

3.17 CAD File Numbering

3.17.1 Contractors CAD File Numbering shall be described in 2.2 above.

3.17.2 The Employer CAD File Numbering. Unlike most of the contractors, the Employer will not be required to produce numerous CAD files. These will follow the numbering system except that the status of the drawing in 2.1(3) shall be "E".

3.18 CAD File Naming Convention - General

3.18.1 CAD “Model Space” files shall be named in accordance with general drawing conventions.

APPENDIX 5

DESIGN CERTIFICATE

This Design Certificate refers to Submission No. ..... which comprises:

[description of the Works to which the submission refers]

The contents of this submission are scheduled in Section A below.
Section A: Submission No. ..... comprises the following:

Drawings: *(Title, drawing number and revision)*

Other: *(Title, reference number and revision)*

(i) . . . . . .

(ii). . . . . .

(iii) . . . . . .

(iv) . . . . . .
etc.

The documents scheduled in Section B below, for which a Notice of No Objection has been issued, are of relevance to this submission.

Section B: Documents for which a Notice of No Objection has been issued and which are of relevance to this Submission No. .....

Item Reference: (Title, reference number and revision)

(i) . . . . . .

(ii). . . . . .

(iii) . . . . . .

(iv) . . . . . etc.

Contractor's Statement

We certify that:

(a) the design of the Works, as illustrated and described in the documents scheduled in Section A above, complies with the General and Technical Specifications

Clause……..

Covering……

……

……

(b) an in-house check has been undertaken and completed to confirm the completeness, adequacy and validity of the design of the Permanent Works as illustrated and described in the documents scheduled in Section A below;

(c) all necessary and required approvals relating to the design of the Works, as illustrated and described in the documents scheduled in Section A, above have been obtained and copies of such approvals are annexed in Section C below;

(d) all effects of the design comprising the submission on the design of adjacent or other parts of the Works have been fully taken into account in the design of those parts.

Name……

Position / Designation……..

Date……..

Signed by Contractor's Authorised Representative

Contractor's Certification

This Certifies that all design has been performed utilizing the skill and care to be expected of a professionally qualified and competent designer, experienced in work of similar nature and scope. This further certifies that all works relating to the preparation, review, checking and certification of design has been verified by us.

Name (for Contractor)

Position/Designation

Signed by 'Authorized Representative' Date

Note 1

The Contractor shall insert one of the following, as applicable:

(i) the Contractor's Technical Proposals

(ii) the Contractor's Technical Proposals and Design Packages Nos. ..... for which a Notice of No Objection has been issued.

(iii) Design Packages Nos. ..... for which a Notice of No Objection has been issued if such Design Packages develop and amplify the Contractor's Technical Proposals.

(iv) The Definitive Design

Section C

[Contractor to attach copies of necessary and required approvals]

(i) . . . . . .

(ii). . . . . .

(iii) . . . . . .

(iv) . . . . . .
etc.

APPENDIX 6

SPARES – See Volume 6 – Price Schedule

APPENDIX 7

1. DESIGN AND MANUFACTURE INTERFACES

1.1 Interfaces

1.1.1 The Contractor shall interface the design, manufacture, supply to that of other contractors as defined in clause 3.4 of the General Specification. The Contractor shall keep the Employer' fully informed in respect of such interfaces, such information being given to the Employer in a manner and form and at such intervals as stated in the Contract or as required by the Employer.

2 Interface Responsibilities

2.1 The responsibility for specification and provision of the requirements for the works that interface with Designated Contractors works are tabulated in this appendix.

2.2 This Appendix describes the interface requirements between the Contractor and Designated Contractors with this Contract.

2.3 This Appendix shall be read in conjunction with the relevant clauses of the General and Technical Specifications. The Contractor shall be responsible for ensuring that all requirements of the specifications pertaining to interfaces are satisfied.

2.4 The requirements specified herein are by no means exhaustive and it remains the Contractors' responsibilities to develop and execute jointly an Interface Plan after the commencement of the works and throughout the execution of works, to ensure that:

(i) all interfacing issues between the two Contracts are satisfactorily resolved;

(ii) supply, installation and testing of equipment and software are fully co-ordinated; and

(iii) that all equipment supplied under the Contract is fully compatible with that supplied under other contracts, whilst meeting the requirements of the respective Specifications.

2.5 Notwithstanding the requirements described elsewhere in the Contract regarding document precedence the provisions contained in the drawings and elsewhere in the General and Technical Specifications shall prevail over the provisions contained in this Appendix.

2.6 This Appendix outlines the interfacing requirements during the execution of the Works. However the requirements herein specified are by no means exhaustive and it remains the Contractor's responsibility to develop, update and execute jointly an Interface Management Plan after the commencement of the Works and throughout the execution of the Works to ensure that:

(i) all interface issues between the Contractor and the Designated Contractors are satisfactorily identified and resolved; and

(ii) all the construction tolerances at the interface shall meet the requirements of the respective specifications relating to the interface points.

2.7 Where details of the Contractor's design are required to enable the Designated Contractor to implement interface works, the Contractor shall provide the Designated Contractors with the necessary information including, but not necessarily limited to, those described in the summary table appended to this requirement. The level of information provided shall be in sufficient detail to enable the Designated Contractors to design and / or construct the required interface work.

2.8 The Contractor shall take a lead in developing the Interface Management Plan. (IMP), which will be prepared in conjunction with the Designated Contractors to cover all aspects of the implementation of the interface works required. The Plan will define the interface works necessary to complete all the works in this contract and may not be limited to those listed in the summary table attached.

2.9 The IMP shall be fully conforming with the Works Programme and shall, in respect of the Contractor and each of the Designated Contractors, show and be in logical agreement with Key Dates. The IMP shall indicate dates for the commencement and completion of each principal activity by each contractor, and delivery and installation of principal items of equipment.

2.10 The IMP shall be submitted by the Contractor to the Employer, in a preliminary form, within sixty days of the date of acceptance of the tender of the Contractor or any Designated Contractor whichever is the later. Thereafter, the IMP shall be updated by the Contractor at regular intervals, not exceeding twenty eight days, agreed with Designated Contractors and submitted to the Employer. Should it appear to the Employer that the progress of the Works, Works Programme or the Three Month Rolling Programme does not conform with the IMP, the Contractor shall be required to revise all such programmes and plans such that they do reflect that are progress of the Works is mutually consistent and conforms to other provisions of the Contract.

2.11 The Contractor shall review the details of interface works and notify the Employer of any amendments to the summary table required in the process of his works. Unless such requests are reviewed without objection by the Employer, the Contractor shall design and construct the Works in accordance with the provisions outlined in this Appendix and the attached summary table.

3 Scope of Work of Integrated Management Plan

3.1 The information and scope of works to be provided by the Contractor include but may not necessarily be limited to those outlined in the attached summary table. This table only defines those tasks at the interface point and is not a complete itemisation of the Scope of Work.

3.2 The Designated Contractors shall liaison with the Contractor in the design, installation, testing and acceptance of the Works.

3.3 The Contractor shall provide all access and attendance necessary in accordance with the Contract requirements to enable the Designated Contractors to complete those activities defined under the summary table attached to this interface specification in a timely manner.

3.4 Where Contractor works are identified as failing to meet the requirements of the Contract and which will impact the Designated Contractor's works, the Contractor shall submit the proposed remedial measures to the Employer for review and shall copy the same to the Designated Contractors.

4 Interfaces among the Contractor and other relevant Designated Contractors have been defined in the Appendix of the TS**.**

APPENDIX 8

ABBREVIATIONS

A0 … A6	International Document Paper Sizes
A/C	Air Conditioning
ac	Alternating Current
ACTM	AC Traction Manual
AGC	Associated General Contractors
AISI	American Iron and Steel Institute
ASTM	American Society for Testing and Materials
ATO	Automatic Train Operation
ATP	Automatic Train Protection
BS	British Standard
CAD	Computer Aided Design and Drafting
CBT	Computer Based Training
CoC	Condition of Contract
CCR	Central Control Room
CCTV	Closed Circuit Television
CGI	Computer Generated Image
CIV	Civil Contractor
CPM	Critical Path Method (works programming)
CPU	Central Processing Unit
CT	Computer Tomography (x-ray machine)
DC	Direct Current
KM-EWL	KOLKATA METRO EAST WEST LINE
DCA	Design Certificate Application
DCC	Depot Control Centre
DIN	Deutsche Industrie Norm
DKE	Dynamic Kinematic Envelope
DLP	Defect Liability Period
KMRC	Kolkata Metro Rail Corporation
DRCA	Design Review Certificate Application
E&M	Electrical and Mechanical
EMC	Electromagnetic Compatibility

EMU	Electric Multiple Unit
EN	European Norm
EPROM	Erasable Programmable Read-Only Memory
FAT	Factory Acceptance Test
FOR	Free On Rail
FRLS	Flame Retardant Low Smoke
FRLSZH	Flame Retardant Low Smoke Zero Halogen
HV	High Voltage
Hz	Hertz (Frequency)
IEC	International Electrotechnical Committee
IP	Index of Protection
ISO	International Organisation for Standardization
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LV	Low Voltage (below 1000V)
E&M	Electrical and Mechanical
MCB	Miniature Circuit Breaker
MMC	Maintenance Management Centre
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
MV	Medium Voltage
NFPA	National Fire Protection Association (USA)
NTP	Notice To Proceed
O&M	Operation and Maintenance
OCC	Operations Control Centre
OCS	Over-head Catenary system
OEM	Original Equipment Manufacturer
PAS	Public Address System
PCB	Printed Circuit Board
PDM	Precedence Diagramming Method
PVC	Polyvinyl Chloride
RAM	Random Access Memory
RDSO	Research, Design and Standard Organization
rms	Root Mean Square

ROM	Read-Only Memory
SCC	Service Comfort Criteria
SI	International System (of Metrication)
UPS	Uninterruptible Power Supply
V	Volts
VCB	Vacuum Circuit Breaker
VCR	Video Cassette Recorder
VDU	Visual Display Unit
VVVF	Variable voltage variable frequency

Appendix - 9

Refer Vol 5 of Tender Documents